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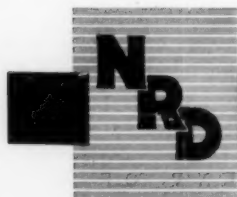


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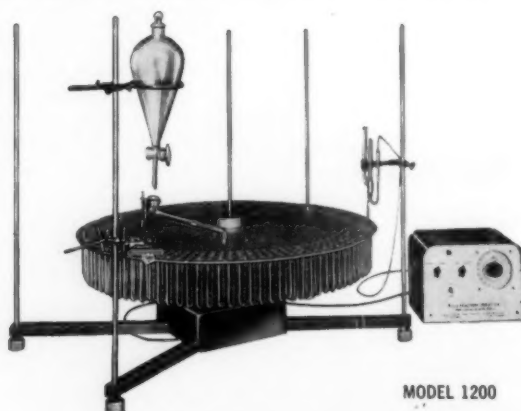
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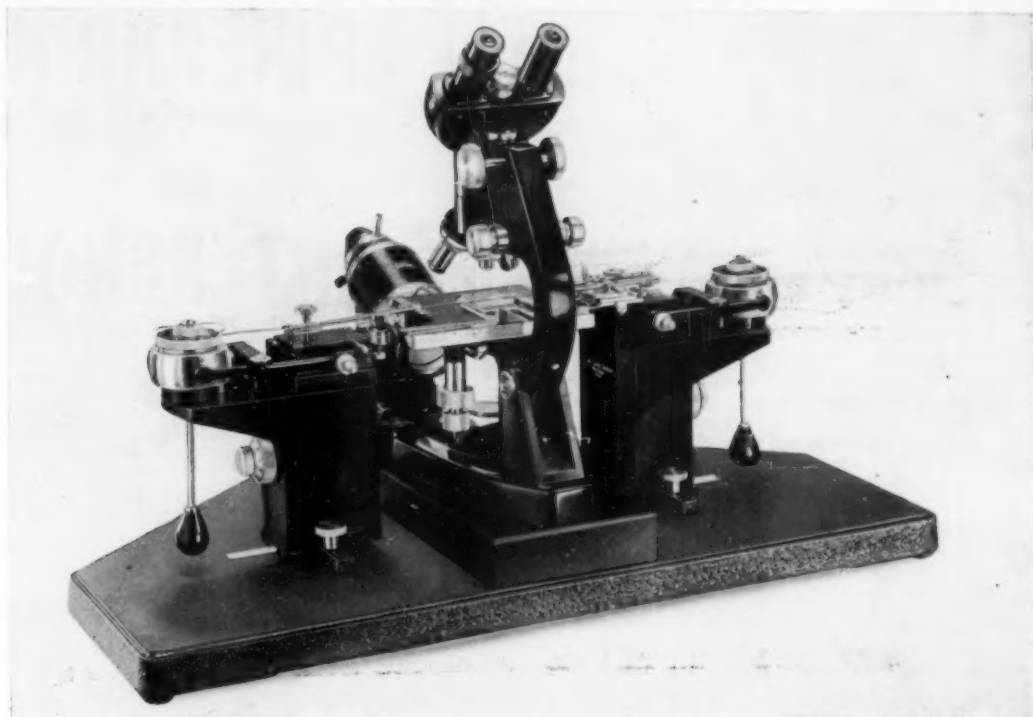
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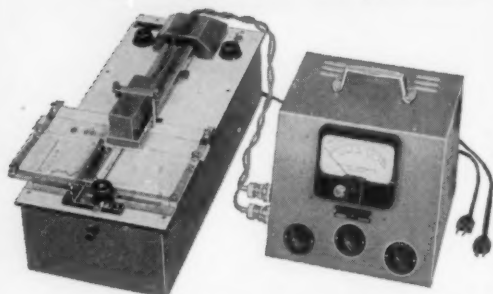
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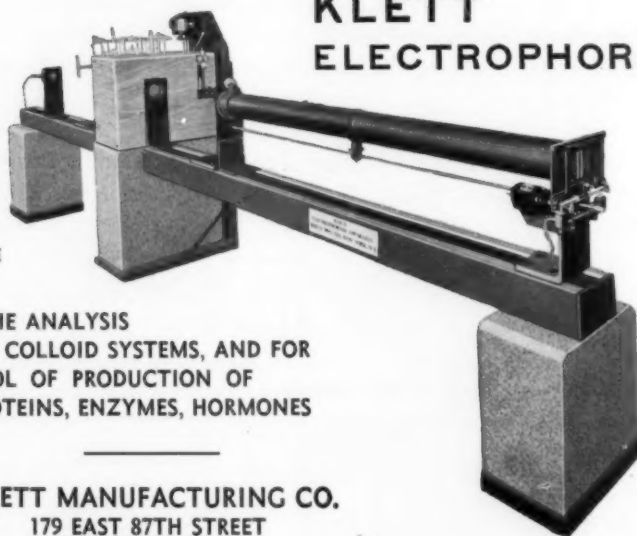
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Grantee Ethics

Science does not have, and hopefully will never need, a formalized code of ethics similar to those of medicine, law, or engineering. Tradition, common sense, and the ordinary ethics of decent regard for others have been sufficient guides in the handling of most problems. But with rapid changes in the role of science and the patterns of financial support, these traditional guides are no longer always sufficient. There is a class of situations in which ethical questions arise, even though there is no implication that the scientists involved are seeking to act unethically. Quite the contrary; many scientists are hunting for answers to such questions as these: In team research, who owns the data? In conflicts between the scientific traditions of free publication and the industrial customs of competition and secrecy, what are the governing principles? Under what circumstances should participation in a group project satisfy the research requirements for a graduate degree? What is an investigator to do when during the course of a subsidized study he uncovers an exciting new lead that looks more promising than the plans he described in applying for support? What is an adviser to do when an agency asks him to review a research proposal on which he has already made an adverse recommendation to another agency?

There is another class of situations in which the tactics employed in seeking funds seem—at least to some observers—to indicate some elasticity of conscience. Perhaps most common is the simultaneous application to two sources of funds for the same work. Occasionally an investigator divides a research project into somewhat artificial parts so that he can send separate applications to different agencies and still satisfy his conscience. Grantees sometimes deliberately slant a research project in an effort to make it appeal to a particular foundation or government agency. In these last two examples, the fault—if there is a fault—is not necessarily that of the grantee. The policies and preferences of agencies that support research sometimes invite slanting of a proposal or the division of a research whole into separate projects. Even so, such situations raise problems concerning the ethics of grant giving and grant receiving.

Once in a while an obvious breach of ethics occurs. Several years ago an applicant for a research grant listed himself as the principal investigator of a proposed study and, almost simultaneously, applied for a Fulbright award for a year abroad during the period his planned research was scheduled to run. In neither application did he mention the other. When asked what he planned to do if both awards were made, he replied that he would turn the research grant over to his assistant. No matter how competent the assistant, his plan seems questionable.

Foundation officials are aware of these problems. They know that clearly unethical behavior is the exception rather than the rule. They know, too, that they are not the proper persons to call such matters to public attention.

What should be done? Individual scientists already know that these problems exist. Perhaps more discussion—a symposium or the publication of expressions of different points of view—might help. On only one point do we feel assurance: if serious consideration of the ethics of scientists in these practical situations is warranted, responsibility for initiating that consideration rests with the scientists.—D. W.



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Biological Response Curves

W. W. Westerfeld

Many growth and biological response curves have a sigmoid shape or can be considered to be portions of S-shaped curves. Such curves are similar to the graphic representations of electron and proton transfers (when all are plotted in an analogous way), and such curves can be described mathematically by using a general equation that is based on the mathematical expressions governing electron and proton exchanges. The purpose of this article is to identify the existing analogies and to show how certain growth and biological response curves conform to this relationship.

The general equation for the sigmoid curves under consideration is

$$X = K + f \log (A/B) \quad (1)$$

where X is one of the variables in the system; K is a constant characteristic of the mid-point of the curve; f is a constant characteristic of the "spread" of the curve; and A/B is the ratio of two components of the system that act as a "buffer" pair.

In proton transfers, the titration curve is described within certain limitations by the familiar Henderson-Hasselbalch equation:

$$pH = pK + \log \frac{[A^-]}{[HA]} \quad (2)$$

For electron transfers, the voltage of an oxidation-reduction system is described by the equation:

$$E_A = E_0 + \frac{0.06}{n} \log \frac{[\text{oxid.}]}{[\text{red.}]} \quad (3)$$

Both of these curves have been plotted in Fig. 1, the first for an acid whose pK is 5, the second for an oxidation-reduction system whose $E_0 = +0.2$ v and $n = 1$ and 2 (other systems would give identical curves). When the two equa-

tions are spread over the same distance on the abscissa, the curve for electron transfers coincides with the curve for proton transfers.

The f components of different S-shaped curves will obviously have no comparative value unless all such curves are considered on the same basis by making each $K = 1.0$. The f of the original curve divided by the original K will then give the F that corresponds to $K = 1$. Whereas the values for f in the original curves for electron and proton transfers are constant irrespective of the absolute value for K , the values for F corresponding to a K of 1.0 vary with the E_0 or pK at which the F is calculated.

An S-shaped curve conforming to the general equation will yield a straight line when $\log (A/B)$ is plotted as the ordinate against $X - K$ as the abscissa, and the slope of the line will equal $1/f$.

Normal Distribution

The Henderson-Hasselbalch equation is derived from the mass action formulation for the ionization of a weak acid:

$$\frac{[H^+] \times [A^-]}{[HA]} = K \quad (4)$$

When the Henderson-Hasselbalch equation (Eq. 2) is differentiated in order to obtain the rate of change of the titration curve (1), the following equation for the buffer value is obtained.

$$\beta = \frac{\Delta B}{\Delta pH} = \frac{2.3 K \times C \times H}{(K + H)^2} \quad (5)$$

As is noted earlier, the usual way of plotting Eq. 2 in the form of $[A^-]/[HA]$ against pH yields a symmetrical S-shaped curve. Plotting Eq. 5 as buffer value against pH gives a normal frequency-

distribution curve. Figure 2 shows the essential identity of such a buffer value curve with a normal distribution curve whose standard deviation is 1.

Thus the normal frequency-distribution curve is related to the symmetrical S-shaped curves that are characteristic of electron and proton exchanges. Thompson (2) has pointed out that "the bell-shaped and the S-shaped curves form a reciprocal pair, the integral and the differential of one another." So far as proton transfers are concerned, both types of curve are derived from the same fundamental mass-action relationship. The mean of a normal distribution curve corresponds to the K of an S-shaped curve, and the asymptotic "limits" of a distribution curve coincide with the practical "limits" of the S-shaped curves for proton and electron transfers. Hence, the mean of a normal distribution curve corresponds to the value obtained with an equal mixture of the two forms making up the "buffer" pair, while the practical limits ($\pm 3\sigma$) correspond to the values obtained when essentially only one of the two possible forms is present.

Response Curves

Many growth curves are symmetrical and identical with the curve for proton and electron transfers. Figure 3 shows the close parallelism between a number of unrelated growth curves and the S-shaped curve for electron and proton transfers shown in Fig. 1 when the abscissas and ordinates for all of these curves are made to coincide.

Some bioassay curves are S-shaped and conform to the same equation when it is expressed as follows.

$$\text{Dose} = K + f \log \frac{(\text{percentage responding})}{(\text{percentage not responding})} \quad (6)$$

Plotting the percentage response as the ordinate is analogous to the usual plot of the ratio of $[A^-]/[HA]$ in a titration curve or the ratios of oxidized/reduced forms in electron transfers; the latter plots could equally well be considered to represent the percentage of acid neutralized or the percentage of a given substance oxidized.

Figure 4 shows the dose-response curves

Dr. Westerfeld is a member of the department of biochemistry in the College of Medicine of the State University of New York, Syracuse, N.Y.

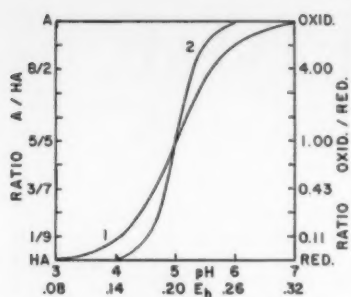


Fig. 1. Curves representing electron and proton transfers. (Curve 1) Titration curve for an acid, $pK=5$, according to Eq. 2. The same curve results from the oxidation-reduction equation, Eq. 3, when $n=1$. (Curve 2) Oxidation-reduction reaction when $n=2$. Curve 2 would coincide with curve 1 if it were spread over the same distance on the x-axis. Note that the ordinate is not a linear plot of the ratio but is a regular progression that corresponds to a percentage of the maximum.

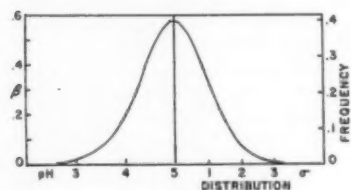


Fig. 2. Comparison of the buffer value and normal distribution curves. The left-hand portion of the curve is a plot of buffer value versus pH for a 1M acid, $pK=5$, according to Eq. 5. The right-hand portion is a frequency-distribution curve where $N=1$ and $\sigma=1$.

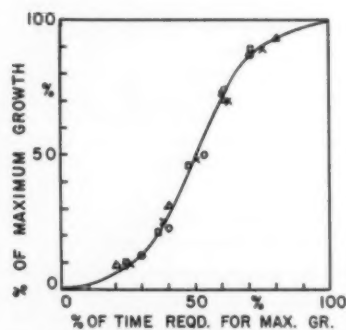


Fig. 3. Growth curves. The solid line is the theoretical S-shaped curve for proton or electron transfers as given in Fig. 1, while the symbols represent points on the actual growth curves published by Thompson (2). \times , Growth of beanstalk to 80 centimeters in 8 days; \square , growth of lupine to 160 millimeters in 21 days; \triangle , prenatal growth of child to 490 millimeters in 10 months; \circ , growth of maize to 80 centimeters in 100 days.

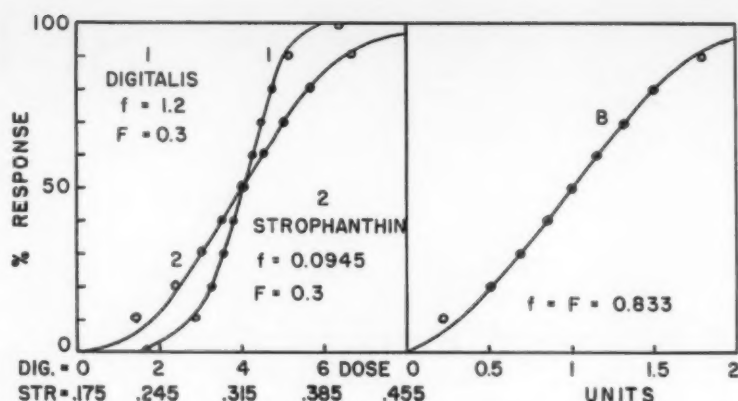


Fig. 4. The solid lines are dose-response curves for the assay of digitalis (curve 1), strophanthin (curve 2), and estrogen (curve B), according to Burn (3, 4). The values for f are calculated by substituting experimental data in Eq. 6. $F=f/K$. The circles represent points calculated for the given values of f .

for the assay of digitalis, strophanthin, and estrogen as given by Burn (3, 4). Calculating the f values to a K of 1.0 yields an $F=0.3$ for both the digitalis and strophanthin curves, and an $F=0.833$ for the estrogen assay. Since the digitalis and strophanthin curves have the same value for F , the two curves are identical and will coincide when they are plotted on the same basis by graphing the dosage as a plus or minus percentage of the dose giving a 50-percent response (4), thereby making $K=1$. When the dose required to produce a 100-percent response is twice the dose that gives a 50-percent response, the resulting S-shaped curve has an $F=0.5$. When the assay range is greater or less than this, the F is correspondingly greater or less than 0.5.

Skewed curves. A skewed distribution corresponds to an unsymmetrical S-shaped curve, as is shown in Fig. 5. The S-shaped curve can be derived from the frequency distribution by calculating the percentage of values that fall below or above any given value. In this "summation curve," the distance between the two quartiles (the 25- and 75-percent points) very nearly coincides with the standard deviation of the normal curve (2). For a skewed frequency curve, the geometric mean is more probable than the arithmetic mean. Since the logarithm of the geometric mean of a series of numbers is the arithmetic mean of their logarithms, the logarithms of the variants and not the variants themselves will tend to obey the Gaussian law and follow the normal curve of frequency (2).

Figure 6A shows the skewed type of dose-response curve that is obtained in determining the toxicity of cocaine in mice (4). Plotting the logarithm of the dose, instead of the dose itself, as abscissa yields a symmetrical curve (Fig.

6B) that follows the general equation. This is similar to a plot of the Henderson-Hasselbalch equation in which the negative logarithm of the hydrogen-ion concentration, rather than the hydrogen-ion concentration itself, is plotted as the abscissa.

Hemisigmoid Curves

If a biological effect starts at the midpoint of a sigmoid curve, only the upper half of the latter will be revealed in a dose-response curve. Such hemisigmoid curves follow the general equation for S-shaped curves when it is recognized that only half of a typical sigmoid curve is under consideration. When they are plotted in the usual way (A/B versus X), these hemisigmoid curves have the shapes illustrated in Fig. 7A. A plot of $\log X$ against A/B yields the curves shown in Fig. 7B. Such a log relationship is obviously not linear, but the central portion of each curve approaches linearity.

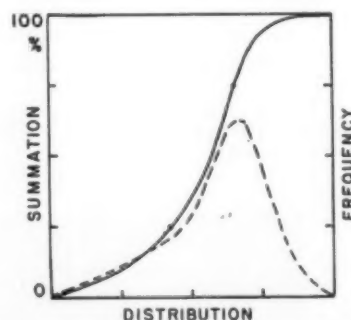


Fig. 5. A skewed distribution curve (dotted line) and its corresponding unsymmetrical S-shaped summation curve.

The ratio A/B is equivalent to the percentage of B converted to A , and it is analogous to the percentage response in a bioassay procedure. In analyzing a hemisigmoid bioassay curve, its origin or zero-dose response is equated to an equal mixture of A and B (corresponding to the mid-point of a sigmoid curve), while the maximum response corresponds to 100 percent of A . The assay range therefore extends from 50 percent of the maximum response (at zero dosage) to a 100-percent response at its asymptotic limit, and the distance in between is apportioned equally. Since the dosage at the beginning of the assay curve is inevitably zero, the K of the general equation for sigmoid curves is also zero and can be dropped from the equation, leaving

$$\text{Dosage} = f \log \frac{\text{percentage of maximum response}}{100 - \text{percentage of maximum response}} \quad (7)$$

when the percentage response is equated to a scale of 50 to 100 percent rather than 0 to 100 percent.

Figure 8 shows the dose-response curves for the bioassay of androsterone and insulin (4). From the experimental curves, the recorded values for f can be calculated. The circles show the close correspondence between the actual assay curves and the theoretical curves calculated with these appropriate values for f . The log dose-response curves show the "linear" central portion that has been used extensively for comparative assay purposes. Assay curves that conform to Eq. 7 will yield a true straight line throughout the assay range when $\log [(\text{percentage of maximum response}) / (100 - \text{percentage of maximum response})]$ is plotted on a scale of 50- to 100-percent response as the ordinate against the dose as the abscissa, and the slope of the line will be $1/f$.

All growth and dose-response curves cannot be represented by the simple relationships described, and similar sigmoid curves can often be represented by very different types of differential equations. However, the examples cited emphasize a fundamental unity of many chemical and biological relationships. Since biological phenomena are dependent on chemical reactions, and since the latter are concerned with electron and proton exchanges, there is a fundamental basis for the analogies and correlations that have been made.

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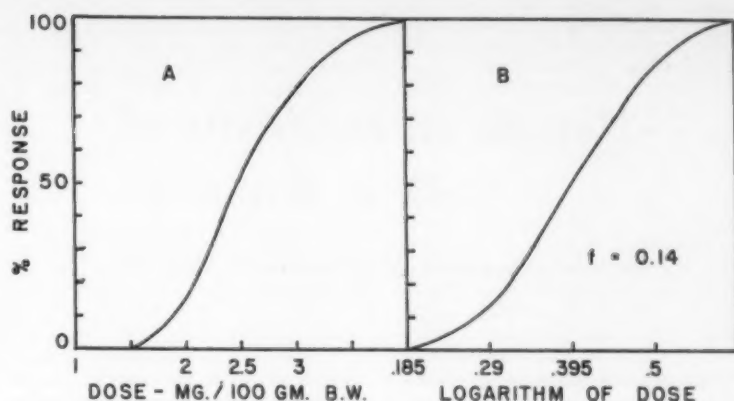


Fig. 6. (A) The unsymmetrical dose-response curve for the toxicity of cocaine in mice (4). (B) The same data plotted as log dose versus response to yield a symmetrical curve that follows the equation: $\log \text{dose} = 0.395 + 0.14 \log [(\text{percentage responding})/(\text{percentage not responding})]$.

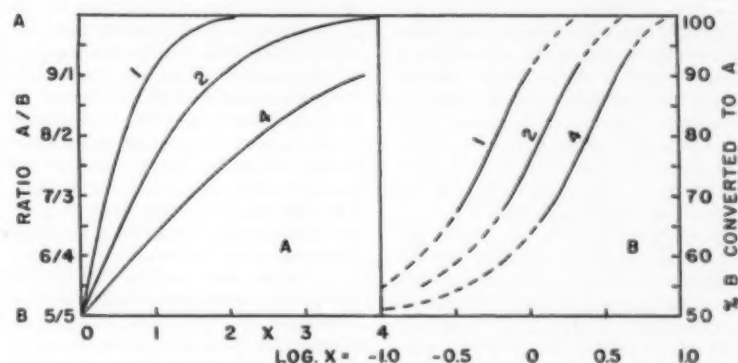


Fig. 7. (A) Hemisigmoid curves according to the equation: $X = K + f \log (A/B)$, when $K = 0$ and only the upper half of the total curve is plotted; $f = 1, 2$, or 4 as indicated. (B) A corresponding plot of $\log X$ (instead of X) against the ratio of A/B .

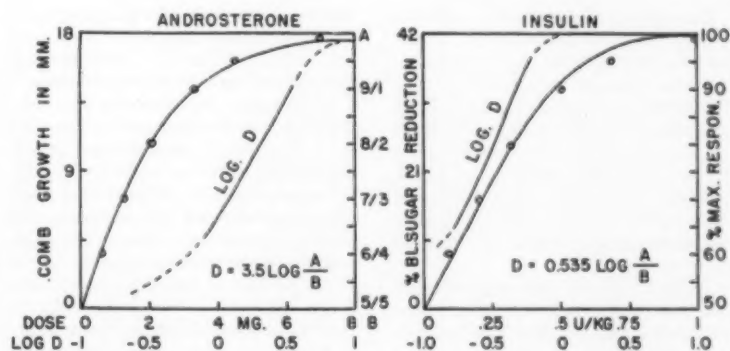


Fig. 8. The solid lines are the experimental bioassay curves for androsterone and insulin (4). The circles are theoretical points calculated from the equation: $\text{dose} = K + f \log (A/B)$, when $K = 0$ and $f = 3.5$ for androsterone and $f = 0.535$ for insulin. The ratio A/B is equivalent to $(\text{percentage maximum response}) / (100 - \text{percentage maximum response})$, with the assay curve starting at the mid-point of a sigmoid curve, that is, at the 50-percent response level. The log dose-response curves are also shown.

Notions on Sensitivity of Cells to Radiation

Ole A. Schjeide, James F. Mead, Lawrence S. Myers, Jr.

The observed sensitivity of cells to ionizing radiation is undoubtedly the product of several factors that are related to structure, metabolism, reproduction, and environment. In spite of a large body of experimental and speculative work, the nature of these factors and their interaction in causing the various types of response and the wide range of sensitivity observed in different kinds of cells are obscure. This is hardly surprising when it is realized that radiation may induce a large number of chemical and physical changes in both the nucleoplasm and the cytoplasm. Some of these changes may have little effect on any kind of cell under any conditions. Others may have a more or less drastic effect, depending on the type of cell and its environment.

In the hope of clarifying some of the significant factors contributing to the radiation sensitivity of cells, we have focused our attention on some of the most radiosensitive cell types (1). These cells are certain cells of the embryo, especially those that are undergoing differentiation (2, 3); differentiating oocytes (4); mature and immature lymphocytes (5, 6); certain tumor cells (6, 7); spermatogonia of mammals (8); subependymal cells (9); and various others, such as specific cells of the small intestine (10).

The response of these cells to radiation is characterized by the following: (i) the end-point is cell death; (ii) death occurs in the interphase or early prophase stage; (iii) death of a large fraction of the population is caused by extremely small radiation doses—10 to 100 roentgens; and (iv) the cells appear to be highly sensitive both *in vivo* and *in vitro*, and death occurs relatively quickly, largely eliminating environmental factors from consideration.

Consideration of the properties of these cells and correlations with recent findings in radiation chemistry and cellular physiology have led us to several

notions related to the cause of the unusual sensitivity of these cells to radiation. Briefly stated, these are as follows.

(i) During ordinary biooxidations, many loci in the cytoplasm of aerobic cells are constantly exposed to oxidizing radicals (probably in complex molecular form) identical to those produced in water by ionizing radiations. (ii) As might be expected, most cytoplasmic systems appear to function normally after moderate doses of radiation. (iii) Unlike the cytoplasm, the nucleoplasm is not exposed to the same degree to oxidizing radicals or their complexes. (iv) The nucleoplasm may lack adequate defenses against these foreign oxidizing agents, and sensitive systems within the nucleus may be considerably injured by radiation. (v) All the aforementioned extremely radiosensitive cells seem to be uniquely dependent on an active nucleus for maintenance and integrity, even during the non-dividing phase. (vi) These considerations suggest that the high radiation sensitivity of these cells is the result of the action of strongly oxidizing, radiation-produced substances on the normally anaerobically metabolizing systems of nuclei in cells in which the nucleus plays an unusually active role in cellular metabolism. (vii) The death of these cells, then, is the result of a sequence of unidentified biochemical changes that occur within the cell and are initiated by damage to an as-yet-unknown system in the nucleus.

(Although in the cells under consideration this "metabolizing nucleus" sensitivity factor plays a predominant role in determining radiation sensitivity, in other cells it must play a more or less important role, depending on the importance of nuclear metabolism to the cell as a whole and on the importance of other factors (11). To take an extreme example, this factor can have no importance whatsoever in the nonnucleated erythrocyte.)

A search of the literature does not answer unambiguously the question of whether death of these cells results from injury to the cytoplasm or nucleoplasm. Numerous studies have been carried out on other cells (12), presumably with such objectives, but only one of these has

given what can be considered a conclusive result. Whiting (13) irradiated female wasps with up to 50,000 roentgens, then mated them with unirradiated males. Normal androgenic development followed, presumably mediated by the unirradiated nucleus. No development of diploid individuals occurred following such a large radiation dose. On the basis of this work she concluded that cytoplasm may function normally after an irradiation dose many times greater than that lethal to the nucleus.

The same conclusion may be drawn from the *in vitro* radiation studies of Barron (14) and others (15) on isolated enzymes. These studies show that, although certain sulfhydryl-containing enzymes are inactivated by fairly low doses of radiation, this inactivation can be reversed by reducing agents such as glutathione, and the enzymes themselves can survive relatively high doses of radiation without irreversible damage. Cytoplasm and tissue fluids normally contain antioxidants and reducing agents of several types in more than adequate concentrations to accomplish this.

Why the cells under consideration differ in radiation sensitivity from other nucleated cells is suggested (i) by morphologic and metabolic comparisons, both of which indicate a considerable nuclear activity on the part of these cells and (ii) by theoretical reasons which lead us to propose that the active nucleus is the most radiovulnerable cellular system.

Morphologic and Metabolic Comparisons

Morphologically, these cells all have a large nuclear volume in comparison with their cytoplasmic volume (3, 4, 16). Another feature is the presence of relatively few cytoplasmic particles and, in particular, a marked paucity of mitochondria (3, 4, 16). A dramatic illustration of how such cellular organization can be correlated with radiation sensitivity is provided by the work of Tahmisan on grasshopper eggs (4). In this insect, the eggs differentiate as they pass down the oviduct, so that the cells closest to the external opening have many cytoplasmic particles, whereas cells higher up the duct have larger nuclei and fewer mitochondria. As little as 100 roentgens will cause the nondifferentiated eggs to disintegrate, whereas approximately 500 roentgens are required to destroy eggs that are about to be laid.

The extraordinary participation of the nuclei of these cells in synthesis and cell maintenance is borne out by their high glycolytic as compared with oxidative metabolism (17). This has been measured by Beck (5) for chronic lymphatic

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leukemic cells and normal leukocytes. The data for leukocytes indicate rather strongly that normal lymphocytes must also have a higher glycolytic rate. Mendel, Rudney, and Bowman (18) have reported high glycolytic rates for the small intestine. Gal *et al.* (19) offer indirect evidence that such a metabolic pattern obtains in many of the tissues of the embryo. They were able to correlate low rhodanese activity with a high rate of glycolysis and found that embryo tissues are extremely low in rhodanese. Potter and DuBois (20) have shown that tumors and embryonic tissues are exceptionally low in cytochrome *c* and cytochrome oxidase. Hicks (3) has shown that the neuroblasts of the rat will tolerate more than 1 hour of total anoxia without breakdown (a finding that also indicates a well-developed glycolytic mechanism), whereas the mature neuron is destroyed by such exposure in only a few minutes.

Thus the available evidence indicates that the extremely radiosensitive cells carry out a relatively large portion of their metabolism via nuclear glycolytic pathways.

Theoretical Reasons

Theoretical reasons, suggesting a relative insensitivity of many cytoplasmic loci and sensitivity of major portions of the nucleus, are provided by current theories on metabolic processes and on the mechanisms by which radiation acts. Convincing evidence has been obtained that, in any oxygenated aqueous system, the primary oxidative irradiation products are H_2O_2 and the free radicals HO_2 and OH (21). These then react with any substances available by conventional oxidation reactions. In irradiated biological systems, these substances are formed, probably along with a smaller number of organic ions and free radicals. Current theories on oxidation-reduction reactions indicate that identical substances, probably as complexes, are produced in cytoplasm during reduction of oxygen to water by the cytochrome oxidase system in normal cell respiration (22). Presumably this reduction takes place in a series of 1-electron steps, giving in turn O_2^- (the anion of the ionized HO_2 free radical), H_2O_2 , $OH+OH^-$, and finally $2OH^-$, or complexes thereof. Since these substances are normally present in respiratory systems, it is not surprising that the introduction of additional small amounts by radiation has little effect. Means for utilizing them in normal metabolic processes are available, and antioxidants such as catalase are present to destroy any that escape normal metabolic routes.

Circumstances in the nucleus are somewhat different. Radiation produces

the same substances as it does in the cytoplasm, but in most of the nucleus they are comparatively foreign. In a recent review, Stern (23) has arrayed a large body of evidence supporting the view that systems of the nucleus exist in an environment in which aerobic oxidation reactions are essentially absent. He points out that, in the many tissues studied, cytochrome oxidase and flavoproteins are absent from the nuclei. Thus it is reasonably certain that the system responsible for the bulk of terminal oxidations is present mainly in the cytoplasm and that the oxygen, which is known to be present in the nucleus, takes little if any part in its metabolism.

This means that many systems of the nucleus, apparently relatively lacking in oxygen-activating enzymes, may be exposed to at most very low concentrations of oxidizing radicals during ordinary existence. Further, it suggests that there is something in the nucleus that is highly susceptible to strong oxidizing agents (24). It might be suspected that nuclei would be low in antioxidants on grounds that seem to have considerable precedence in biological systems—namely, that a defense does not exist where danger is minimal. Supporting this notion are the findings of several investigators that a major antioxidant, catalase, is present only in low concentrations in tumor and embryonic cells (large nuclei) as well as in lower organisms that lack cytochrome systems (25). In this connection, Barron's *in vitro* studies may have bearing on the radiation-induced reaction. In discussing the sensitivity of cytoplasm to radiation, it was pointed out that the sulfhydryl enzymes are inactivated *in vitro* but that they are readily reactivated by a number of substances such as the antioxidants found in the cytoplasm. In the nucleus, in the absence of appreciable amounts of antioxidants, such reactivation probably would not occur. Any sulfhydryl groups inactivated by the radiation might be permanently lost to the nucleus.

The extent to which such impairment from this or any other cause would be apparent in the whole cell during the interphase stage would depend on the relative importance of nuclear metabolism to the cell. Cells that are especially dependent on the nucleus for existence, as are the cells under consideration, would be expected to be unusually sensitive to radiation.

Conclusion

In presenting these notions, we are aware of the lack of sound experimental foundation in several instances. Data showing whether each cell listed conforms in all respects to the notions are

not available. It is possible to interpret some of the available data as showing that cytoplasmic enzymes may be directly inhibited or destroyed by low doses of irradiation. It could then be argued that certain cytoplasmic enzyme systems present in these predominantly nuclear cells are (i) necessary to the continued functioning of the cell, (ii) vulnerable because of low concentration, and (iii) are thus the critical systems affected by radiation. However, such an interpretation does not seem to be as consistent with the totality of the available observations and with the basic theories as does the interpretation presented here.

Certain cells that seem to belong to the nuclear-dependent group do not show the expected sensitivity. For example, the cells of myeloid leukemia appear to be morphologically and metabolically similar to those in the group characterized by radiosensitivity, but they are apparently not killed in interphase by moderate doses of radiation, although mitosis is prevented (26). Assay of the distinguishing properties of these and other exceptional cells should be of first importance for developing a further understanding of cell sensitivity to radiations.

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Zeno Payne Metcalf, Distinguished Entomologist

Zeno Payne Metcalf was a tireless worker to the very last, for he was in his office working on the catalog of the Homoptera of the world until noon of the day he died. He devoted his whole professional life to North Carolina State College and brought international repute to that institution. He died at his home at Raleigh, N.C., 5 January 1956. Even though he had suffered poor health for many months, he died quite suddenly and unexpectedly while talking to his wife and daughter.

Dr. Metcalf was the author of nine books and an active member of 36 learned and professional societies. He was a key speaker at the International Congress of Zoology, which convened in Paris in July 1948, and at the International Congress of Entomologists, which met in Stockholm in August 1948. In addition, he was president of three major national scientific organizations, the Entomological Society of America, the Ecological Society of America, and the American Microscopical Society—a distinction that is

accorded few scientists in the United States.

Dr. Metcalf also served on the editorial boards of four national professional journals and was the author of 96 professional publications. At the time of his death he was engaged in preparing a 42-volume catalog of the Homoptera of the world. Fifteen volumes had been or were in press at the time of his death, and several more volumes are almost ready to go to press. An attempt is being made to provide means of completing the entire set of 42 volumes. Dr. Metcalf has spent much of the past 40 years collecting notes for the series. In an effort to obtain material, he read and checked more than 20,000 books and papers dealing with insects and visited all the principal libraries in the United States and England. The order Homoptera comprises about 4000 described genera and 30,000 described species. The catalog now contains 512,000 references, probably the greatest catalog of any order of insects to be found anywhere in the world.

A native of Lakeville, Ohio, Dr. Metcalf was educated at Ohio State University, where he received his A.B. degree in 1908, and at Harvard University, where he earned his D.Sc. degree in 1924.

Prior to joining the North Carolina State College Faculty in 1912 he was an instructor in entomology at Michigan State College (1907-08) and was on the staff of the North Carolina State Department of Agriculture (1908-12). He joined the North Carolina State College faculty as entomologist with the experiment station and as professor of zoology and entomology. He was visiting professor in the summer session at Ohio State University in 1916 and 1918 and in the summer session at the University of Michigan in 1926. During the school year of 1935-36 he served as visiting professor of zoology at Duke University. Dr. Metcalf was head of the department of zoology and entomology, North Carolina State College, from 1912 to 1950. He was director of instruction in the School of Agriculture at North Carolina State College during the years 1923-44; director of graduate studies at the college, 1940-43, and associate dean of the Graduate School of the Consolidated University, 1943-50. He retired from administrative duties in 1950 and later devoted his full time to teaching, research, and writing.

He was active in both civic and professional affairs and was a former president of the North Carolina Academy of Science. He was also a fellow of the American Association for the Advancement of Science and the Entomological Society of America.

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Natural laws there probably are, rigid and unchanging ones at that. Understand them and they are beneficent; we can use them for our purposes and make them the slaves of our desires. Misunderstand them and they are monsters who may grind us to powder or crush us in the dust.—HENRY A. ROWLAND.

John Punnett Peters, Medical Scientist

John P. Peters was one of the foremost medical scientists of his generation, a man of selfless rectitude who never spared himself and who played as energetically as he worked. He believed in the equality of all men and in their basic rights in society, and, in the face of any seeming injustice, he never hesitated to voice his opinions.

Branded some years ago as a subversive by unsolicited "informers," he eventually took his case, at great expense to himself, to the highest court in the land and was exonerated. At a memorial service, held on 3 January in the Yale Medical Library, Fowler V. Harper pointed out that a 17th-century ancestor of Dr. Peters, one Andrew Peters, had protested against the witch trials at the Salem assizes and that the Peters family had been protesting about witch hunts ever since.

Born on 4 December 1887, the son of Reverend John P. Peters, rector of St. Michael's Episcopal Church, New York, and Gabriella Brooks Forman, John Peters received his early education at Trinity School in New York (1896-1900) and was later sent, in the hope of subduing his rather tempestuous nature, to St. John's School at Manlius, a New York military academy (1900-04), from which he was eventually graduated as "top boy" with distinction in English and the classics.

After taking his A.B. degree at Yale in 1908, he taught English and Latin for a year at Manlius to obtain funds to enable him to enter medical school, which he did the following year at the College of Physicians and Surgeons, New York, where he took his M.D. degree in 1913. After serving as house officer at the Presbyterian Hospital 1913-15, he became captain in the U.S. Army Medical Corps (1917) and saw action in World War I as chief of medical service of the U.S. Base Hospital No. 2 (Presbyterian), which took over British General Hospital No. 1 at Etretat (1918-19).

His academic advancement was rapid; he first became Coolidge fellow and instructor in clinical medicine (1915-17) and assistant physician, Presbyterian Hospital (1916-17), fellow of the Russell Sage Institute of Pathology (1919-20), instructor in clinical medicine at Cornell University and, at the same time, adjunct visiting physician at Bellevue Hospital (1919-20). He was called to Vanderbilt University as associate professor of medicine (1920-21) but spent the year at the Rockefeller Institute in New York, where he worked on problems of clinical chemistry with Donald D. Van Slyke. In 1921 he came to Yale University with his close friend, Francis G. Blake, as associate professor of medicine and associate physician at the New Haven Hospital, with Blake as professor and head of the department; in 1927 he succeeded George Blumer as John Slade Ely professor of medicine, a post that he held until his death at the age of 68. Dr. Peters would have retired in June 1956.

Peters was a man of many interests, professional and other. His first scientific publication, "Carbon dioxide acidosis, the cause of cardiac dyspnea," was published in the *American Journal of Physiology* [43, 113 (1917)], while he was serving as Coolidge fellow at the College of Physicians and Surgeons. This was followed by more than 200 articles in various medical and biochemical journals on general problems of electrolyte and acid-base equilibrium, chemistry, and metabolic disturbances in various diseases, especially diabetes, nephritis, nutritional and endocrine disorders, and studies of transfer of water in the body.

In recent years he published a number of papers in the lay and medical press on the improvement of medical care in the United States. In 1931 and 1932 appeared a two-volume work, *Quantitative Clinical Chemistry*, written in collaboration with Van Slyke. At the time of Peters' death, they were preparing a new

edition of this monumental work. Well known also was his short monograph entitled, *Body Water; the Exchange of Fluids in Man*. Thus, his scientific interest was always in the application and integration of quantitative chemical methods to the clinical problems of disease.

His chief interest in recent years was in medical economics, especially the cost of medical care, and he served (1937-49) as secretary of the committee of (400) physicians that urged nationalization of health services in the United States. The members of this committee felt that the American Medical Association, as an organization, had incurred the distrust of the public because of its stand in opposition and that lay bodies interested in social questions were pressing the government to impose some program for medical care without the expert advice of physicians. They therefore devised a set of principles and proposals—generalizations that seemed to represent approximately the consensus of their opinions concerning the policies that should be adopted by the medical profession to assure the best progress of medicine in the interests of the public.

A committee was formed to promulgate these resolutions and to gain the support of the members of the medical profession for them. The outstanding aim of the committee was to bring the medical profession itself to take the initiative in public service in its own field. The principles and proposals received considerable publicity and at least stirred up healthy discussion throughout the medical world.

Dr. Peters followed his avocations with as much zest for life as he did his professional and outside interests. In *Who's Who* he listed his hobbies as "piano, tennis, squash, sociology, and roses," and each one might have occupied his time fully. Everything about him was elastic except his stomach (he always ate lightly) and his conscience.

He was an ardent disciple of full-time medicine, and at no time in his entire career did he accept a fee for his services; any voluntary contributions from patients were used to support his research. Best known professionally as a biochemist, Dr. Peters took great pride in his work as a practicing doctor. As attending physician at the New Haven Hospital since 1921, he made rounds daily.

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No great law in Natural Philosophy has ever been discovered for its practical applications, but the instances are innumerable of investigations apparently useless in the narrow sense of the word which have led to the most valuable results.—LORD KELVIN.

News of Science

Abominable Snowman

During recent years, stories have been coming out of India and Tibet about a giant mammal that lives above the snow line. According to some accounts, this creature is more than 7 feet in height, walks erect, has an apelike head and face, and is covered with heavy blond or reddish hair. The name "Abominable Snowman" has been given to the animal; the implication, of course, is that it is some sort of giant primate.

Huge footprints in the snow, at heights of from 10,000 to 21,000 feet above sea level, and attributed to the "snowman," have been reported by a variety of people, including members of various Himalayan expeditions. From the latter source have come actual photographs of the footprints, which could pass for those of a large primate. Indeed, it has even been suggested—perhaps with more levity than seriousness—that the "snowman" may be no other than the giant ape, *Gigantopithecus blacki*, persisting as a relic of the Pleistocene epoch in the seclusion of the Himalayas. This, of course, is at best no more than sheer speculation. As a matter of fact, *Gigantopithecus* itself is of decidedly uncertain status, being founded on three molar teeth, probably of Middle or Upper Pleistocene age, recovered from a Chinese drugstore in Hong Kong.

In connection with the matter of identification, it must be emphasized that there is no record of any "snowman" ever having been captured—either alive or dead—or even photographed. Identification rests solely upon the footprints and verbal evidence. It must be admitted that the footprints do bear some resemblance to those of a primate; on the other hand, they could as well be those of a bear. This alternative is not as strange as it may seem offhand, for the general superficial resemblance of ursine and primate feet has long been recognized by naturalists and comparative anatomists.

Wood Jones [*Hallmarks of Mankind* (1948)] points out that the animal footprint most commonly mistaken for that of man is that of the bear; in this connection, he notes that the footprint of the mysterious "orang pendek," once be-

lieved by both natives and Europeans to be that of some small jungle race of men, finally was proved to be the footprint of the Malayan bear. Furthermore, many bears readily stand erect and even indulge in bipedal locomotion on occasion. Consequently, the identification of the "abominable snowman" as a bipedal primate has been vigorously rejected by many zoologists and anthropologists. To most of them, a large bear seems a more acceptable and more plausible explanation.

The question of the nature of the "abominable snowman" has been investigated by the Rev. Swami Pranavananda [*Indian Geographical J.* 30, 99 (July-Sept. 1955)], who concludes that the animal is no other than the red bear of the Himalayas. According to the author, the "snowman" is known to Tibetans as *mi-te*, meaning "man-bear." There are three varieties of bear in this region: black, brown, and red. The last of these is the *mi-te*, which is known to walk on its hindlegs like a man. The author reports several accounts of the *mi-te* gathered from Tibetan eyewitnesses.

A shepherd from eastern Tibet, whose sheep had been attacked by the animal at a height of 16,000 feet along the Kyang Chu, a tributary of the Brahmaputra, stated that the *mi-te*, after first running on all fours, rose on its hindlegs and departed following ineffectual gunfire from the shepherds; it was described as of about the height of a man and light red or reddish brown in color. A number of pilgrim nomads from northern Tibet identified the *mi-te* as the red bear and reported having encountered it at a height of 17,000 feet in the source region of the Kubi, a headstream of the Brahmaputra.

According to another informant, a *mi-te* was seen by shepherds near Tomomopo, on the Tag Tsangpo, on the southeastern side of Manasarovar, at a height of 15,000 feet. At times it moved on all four legs; at others, on its hindlegs alone. When erect, its height was a little greater than that of a tall man. The body was covered by a thick coat of reddish-brown hair. The footprints, left on hard ground scantily covered by sand, measured 11 inches in length and 5 inches in breadth. Although the imprints of the

hind feet had five toes, those of the front feet exhibited only four toes. The toes in general were of about equal length, approximately 1½ inches; the little toes, however, were slightly shorter.

Ten days later, when the shepherds had gone up the valley to graze their sheep, they encountered footprints of the *mi-te* in the snow. These prints were considerably larger than those left in the sand, measuring 18 inches in length with a corresponding increase in breadth; furthermore, no traces of the toes remained. This was obviously due to melting of the snow at the edges of the imprint after long exposure to the sun, with consequent enlargement of the entire impression.

Pranavananda notes that footprints in the snow are subject to change in dimensions, deformation, and obliteration of details (such as impressions of toes), not only through the action of the sun, but also as a result of blizzards or strong winds. When crossing Khandosanglam Pass in 1941, he came across giant footprints. Khandosanglam is a pass east of Kailas, a holy peak; according to Tibetan tradition it can be negotiated only by those pious pilgrims who have completed 12 circumambulations of Kailas by the regular parakrama route. Hence perhaps one or two pilgrims negotiate this pass in a year. It was ascertained that a lama had crossed the pass some 25 days earlier. His were the footprints encountered by the author. As a result of the warm July sun, the deep snow along their edges had melted away, producing a trail of greatly enlarged prints that were 21 inches long and correspondingly increased in width.

It is not difficult to see, as the author points out, how a superstitious pilgrim might have readily described such footprints as those of a great 1000-year-old Himalayan Yogi or as those of Hanuman or some other legendary character; indeed, they might well have been described by some Himalayan expedition as the footprints of an "abominable snowman" or even by a credulous anthropologist as those of a prehistoric man. Nor is there any reason why the snow footprints of the red Himalayan bear might not suffer similar misinterpretation.

According to Pranavananda, the red bear is not the only mammal that frequently makes excursions far onto the snow fields and glaciers, apparently chiefly in search of food. The wild yak, Tibetan wild horse, lynx, snow leopard, wolf, ibex, bharal, ghural, Tibetan antelope, musk-deer, and other animals do likewise, for vegetation can occur up to an altitude of 20,000 feet or more. Their footprints also can be so altered by sun, blizzard, and wind as to be capable of being misinterpreted. The author believes that the footprints reported by Eric Shipton as attaining the size of those

of a young elephant were those of a lynx, snow leopard, or wolf magnified by melting of the snow at their edges.

Some people, while not accepting the "snowman" footprints as those of a giant bipedal primate, have nevertheless regarded them as primate in origin and have attributed them to the langur or black-faced Himalayan monkey. Pranavananda, however, rejects this interpretation, since the langur is seldom or never seen above the tree line and, hence, does not wander on the snow. Moreover, he says, langurs in the upper Himalayas move down to lower, warmer regions well in advance of the snowfall.

Another probable factor in the creation of the "abominable snowman" legend is a linguistic one. The author notes that different persons have translated differently—and sometimes grossly mistranslated—the original local Tibetan words designating the animal that has been identified as the "abominable snowman." In this connection, it is to be noted that most of the current "snowman" stories come from India rather than from Tibet itself. It appears likely that mistranslation of local Tibetan words by foreigners has been responsible for some misconception.

The fact that the matter has not been thoroughly investigated on the Tibetan side of the Himalayas—where the local population has a correct knowledge of the identity of the animal—has helped perpetuate the wrong conception of the animal, according to Pranavananda's view. *Mi-te*, which has been translated by some Himalayan expeditionists as "abominable, filthy, disgusting to a repulsive degree, dirty," actually means "man-bear." *Kangmi*, or "snowman," is merely an alternate word for the same animal. Hence the term *miteh-kangmi*, from whence "abominable snowman," represents an incorrect combination, owing to mistranslation, of two terms that are essentially synonymous.

Thus the "abominable snowman" would seem, on the basis of the best evidence now available, to be no other than the Himalayan red bear. The matter, of course, cannot be conclusively settled until a specimen of undoubted "snowman" is secured for study.

WILLIAM L. STRAUS, JR.

Johns Hopkins University,
Baltimore, Maryland

New Fossil Plants

Roland W. Brown of the U.S. Geological Survey has described several previously unknown species of fossil plants that he found among specimens recently acquired by the U.S. National Museum. In a report on "Paleobotany—new items in Cretaceous and Tertiary floras of the

western United States" that appeared in a recent issue of the *Journal of the Washington Academy of Science*, Brown states that while some of these new additions to the museum come from localities and formations already known, others are from strata not yet named. Therefore, they will contribute toward the dating of the strata as well as to a clearer concept of the species the plants represent. Rather than postpone their description to an uncertain time when monographs can be published, it was decided to present the essential facts immediately.

The newly described species include two ferns, two legumes, and others. Of special interest is a small leaflet that has been identified as "the first unequivocal fossil foliage of *Ailanthus*." Hitherto, Brown points out, the assignment of leaflets to the same species as well-recognized seeds from identical localities, has left much to be desired. None of the leaflets so assigned has clearly shown the characteristic basal, glandular teeth.

In the museum's newly described specimen, however, all the features are comparable with those seen in modern, living *Ailanthus*, especially the glandular tooth. This means that the *Ailanthus* has known ancestors as far back as the mid-Eocene period of geologic history, with evidence now based on leaf structure as well as on fruit. Brown named his find *Ailanthus eureka*.

Great Bahama Bank

The first members of a team of nine research workers and their assistants left New York recently to continue work on a geologic and ecologic survey in the West Indies that may throw new light on the relationships between present-day communities of living organisms and those that existed thousands of years ago. The expedition, which is led by Norman D. Newell, curator of historical geology at the American Museum of Natural History, will make use of such techniques of investigation as skin diving and underwater and aerial photography in an attempt to bring back evidence of the history of life to be found in the waters of the Great Bahama Bank.

The Bank is a limestone platform of some tens of thousands of square miles, almost entirely covered by shallow seas, that is southeast of Florida. Portions of the platform rim projecting above the water constitute several of the Bahama islands. This region is of special interest to geologists because it is one of the few examples of a shallow limestone sea such as those that long ago covered North America.

The expedition is the second in a 3-year project. The study includes comparisons of living plants and animals

with their fossil counterparts, which are found in abundance petrified in the rocks of Bimini. This comparison will be a test of the limitations of fossil sea animals in general as indicators of past environmental conditions.

The expedition will remain in the field for 6 weeks. Base of operations will be the Lerner Marine Laboratory. The American Museum's field station on North Bimini Island.

Peat as a Binder

Edgar L. Piret, professor of chemical engineering at the University of Minnesota, has reported that a research team working under the sponsorship of the state's Iron Range Resources and Rehabilitation Commission has found that ground peat reinforced with an alkali solution is an excellent binder for the balling or pelletizing of powdered taconite concentrate. As it is mined, taconite contains only about 25 percent iron. Since this iron content is too low for direct feed of the rock to the blast furnaces, the ore must be concentrated. This is accomplished by grinding taconite into tiny particles and then separating the magnetic iron from the mother rock in magnetic separators.

The resulting purified ore contains about 62 percent iron but is much too fine for the blast furnace. To obtain a suitably loose packing that will allow the furnace blast to pass through the ore during the smelting operation, it is necessary to form the powdered ore into ½- to ¾-inch pellets in a balling drum. The pellets then are baked or sintered in a furnace to strengthen them so that they will withstand handling, shipping, and feeding into the blast furnace.

Scientists in the News

JOHN A. BEHNKE, associate administrative secretary of the AAAS, will resign on 30 June to accept a position as vice president and science editor of the Ronald Press Company, New York.

WALTER H. ZINN, director of Argonne National Laboratory, has been presented with a special commendation by the U.S. Atomic Energy Commission. The presentation was made at a luncheon given in honor of the recipient by the University of Chicago. The citation read:

"In recognition of his achievements as scientist and administrator in the U.S. Atomic Energy Commission program beginning with essential contributions to the production of the world's first self sustaining chain reaction on December 2, 1942 and continuing during 10 years of

service with distinction as Director of Argonne National Laboratory.

"Dr. Zinn has been responsible for advances of the first order of importance in the development and application of nuclear science, particularly in the achievement of practical atomic power where his work ranks as a foremost contribution to the harnessing of nuclear force in the peaceful service of mankind."

CHARLES R. BURROWS, director of Cornell University's School of Electrical Engineering, will join the Ford Instrument Company, a division of the Sperry Rand Corporation, on 1 July. He will become vice president for engineering.

GOTTHOLD STEINER, plant nematologist for the U.S. Department of Agriculture for 34 years, and head of USDA work on nematodes for the past 24 years, retired on 30 Apr. ALBERT L. TAYLOR of the horticultural crops research branch of the Agricultural Research Service succeeds Steiner as head of the branch's nematology section at Beltsville, Md.

Steiner was born in Switzerland and received his scientific training at the University of Berne and the University of Zurich. Before entering the Department of Agriculture he held a research fellowship at Yale University. Recently he left for Puerto Rico, where he will carry on nematode research at the Puerto Rico Experiment Station in Rio Piedras.

HAROLD S. RENNE, until recently technical editor in the electronics group at Ziff-Davis Publishing Company, has resigned that position to join Bell Telephone Laboratories, New York, as technical information supervisor.

W. A. PULVER, chief manufacturing engineer of the California Division of the Lockheed Aircraft Corporation, has been named assistant chief engineer of the company's Georgia Division at Marietta.

W. HERBERT BIXBY, professor of electrical engineering at Wayne University, recently was honored at a special luncheon given in recognition of his 20 years of service. He will leave the university on 1 July to become vice president and director of applied research for the Power Equipment Company, Columbus, Ohio. He is a specialist in voltage regulation and holds a number of patents in the field.

MARGARET A. KENNARD, former director of mental health research at the University of British Columbia, Vancouver, Canada, has assumed a similar position at the Mental Health Research Institute, Fort Steilacoom, Wash.

KENNETH E. CASTER, professor of geology at the University of Cincinnati, is the first recipient of India's new Gondwanaland gold medal. To be awarded every 3 years, the medal is for the scientist making the most significant contribution to the geology of Gondwanaland, the geological name for the areas now embracing South America, Africa, Madagascar, India, Australia, and Antarctica.

During the past 15 years Caster has carried out field studies in South America, Africa, and Tasmania, and he will be in Australia from June until his return to Cincinnati for the 1956-57 academic year. He has just completed a visiting professorship at the University of Tasmania in Hobart.

The medal, which commemorates the centenary of the Indian Geological Survey, is administered by the Mining, Geological, and Metallurgical Institute of India. RAM KUMAR AGARWALA of Grestien Mica Industries, Ltd., provided an endowment to support the award.

DOROTHY W. WEEKS, professor of physics at Wilson College (Chambersburg, Pa.) has left the faculty after 26 years of service to accept a position as a physicist with the Ordnance Materials Research Office at the Watertown Arsenal, Watertown, Mass.

MELVIN CALVIN, professor of chemistry at the University of California, Berkeley, and director of the bio-organic division of the Radiation Laboratory, has received the Theodore William Richards medal of the American Chemical Society's Northeastern Section. He was honored primarily for his years of research on photosynthesis.

Reporting on the latest results of his work, the medalist stated that with co-workers he had succeeded in doubling, and even tripling, the production rate of sucrose in plants by the use of chemical agents that could influence certain biochemical reactions. This, he said, is an indication that the growing processes of living plants can be manipulated "so as to determine the nature, or at least the amounts, of storage products in the plant."

RENÉ-GUY BUSNEL, director of the new Laboratoire de Physiologie Acoustique of the Institut National de la Recherche Agronomique de France, which is in Jouy-en-Josas, is in the United States on a tour during which he will lecture at colleges and universities throughout the country and at the Wright-Patterson Air Base and the Mayo Clinic. While here, Busnel also plans to conduct research with Hubert Frings of the department of zoology and entomology at Pennsylvania State University.

VICTOR K. LAMER, professor of chemistry at Columbia University, has been elected to membership in the Royal Danish Academy of Sciences and Letters.

LEE A. DuBRIDGE, president of the California Institute of Technology, has been elected a member of the board of trustees of the Rockefeller Foundation.

HUGH H. HUSSEY, professor of preventive medicine and public health at Georgetown University, has been named director of the department of medicine. He succeeds HAROLD JEGHERS, who has resigned to join the department of medicine in the newly established medical school at Seton Hall University.

ROBERT E. DAVIES has been appointed professor of biochemistry in the School of Medicine at the University of Pennsylvania. Prior to his recent arrival at the university, he was for 10 years a member of the British Medical Research Council. For the past 2 years he has worked with a unit at Oxford University, England. His special studies have dealt with muscle contraction and with the production of acids in the stomach.

ROGER H. CHARLIER, who since September 1955 has been a special lecturer in geology and physical geography at Hofstra College, has been named chairman of the department of geology at Hofstra, effective 1 Sept.

REAVIS C. SPROULL, industrial chemist who resigned recently as director of the Herty Foundation Laboratory, has been named director of technical services for the research department of Philip Morris, Inc.

MICHAEL J. S. DEWAR, professor of chemistry at Queen Mary College, University of London, England, has been named visiting professor of chemistry at Yale University, effective 1 July.

FRITS W. WENT, professor of plant physiology at the California Institute of Technology and director of the Earhart Plant Research Laboratory, has been elected a corresponding member of the French Academy of Sciences. There are only 116 corresponding members throughout the world. Went was honored for his work on plant hormones and the influence of environment on plant growth.

E. JAMES ARCHER, assistant professor of psychology at the University of Wisconsin, has received one of the two \$1000 Kieckhefer teaching awards that the university gives annually to young staff members who have shown outstanding teaching performance.

WOLFGANG FINKELNBURG, physicist at Siemens-Schuckertwerke AG., Erlangen, Bavaria, Germany, will participate in the High Temperature Symposium that is to be held at the University of California, Berkeley, 25-27 June. The symposium, which has as its theme "High temperature—a tool for the future," is being sponsored jointly by the university and the Stanford Research Institute. The U.S. Army Office of Ordnance Research is sponsoring Finkelburg's trip.

JOSEPH B. PLATT, chairman of the physics department at the University of Rochester, has been named president of Harvey Mudd College, Claremont, Calif. He will assume direction of the new college of science and engineering on 1 Sept. Incorporated last December, Harvey Mudd College will enroll its first class in September 1957.

Recent Deaths

WARD C. BOWEN, Elmsmere, N.Y.; 64; geologist; director of visual education for the New York State Education Department; 22 May.

WILHELM B. BRONANDER, Sr., Montclair, N.J.; 68; mechanical engineer; president of Scandia Manufacturing Company; 18 May.

ROBERT W. BUZZARD, Washington, D.C.; 52; project leader in the metallurgy division of the National Bureau of Standards; 3 May.

WILLIAM FOSHAG, Westmoreland Hills, Md.; 62; head curator of the department of geology at the Smithsonian Institution; specialist in gems; 21 May.

FRED GREGG, Washington, D.C.; 89; former teacher of natural sciences at Wayne State Teachers College, Peru Teachers College, and Nebraska Wesleyan University; 21 May.

MARTHA M. KENNERLY, Tucson, Ariz., and White Post, Va.; 83; retired assistant professor of biology at Hunter College; 22 May.

J. R. NELSON, Arlington, Mass.; 56; authority on vacuum tubes; director of work on transistor applications for the Raytheon Manufacturing Company; 18 May.

THOMAS A. C. RENNIE, New York, N.Y.; 52; professor of social psychiatry at Cornell University Medical College; 21 May.

FREDERICK P. REYNOLDS, Santa Barbara, Calif.; 88; former executive secretary of the committee on medical education of the New York Academy of Medicine; army officer during World War I and later professor of military hygiene at the U.S. Military Academy; 18 May.

NATHANIEL McL. SAGE, Brook-

line, Mass.; 66; civil engineer; director of the office of sponsored research and placement officer at Massachusetts Institute of Technology; 14 May.

Education

■ Stanford University has appropriated \$45,000 for additional office and shop space in a new wing that is to be added to the Microwave Laboratory, one of the two buildings that make up the W. W. Hansen Laboratories of Physics. The wing will free space in the High-Energy Physics Laboratory, where the 220-foot Mark III linear accelerator is located.

After other plans for remodeling the accelerator are completed, the extra space will be used to add 40 feet to its length. These changes are expected to increase the machine's output of energy by at least 200 mev.

Previously announced plans for expansion of the Microwave Laboratory called for a \$160,000 addition; the revised plans raise the amount for new construction to \$205,000. The new wing will nearly double the present size of the laboratory, which was built in 1954 at a cost of \$200,000.

■ The University of Texas Medical Branch, Galveston, has announced a 5-year, \$250,000 research project in muscular dystrophy that is being sponsored jointly by the university and the National Muscular Dystrophy Research Foundation. The Medical Branch also has announced that it plans to establish a muscular dystrophy clinic, the first in that part of the United States.

■ The establishment of a laboratory for research in parapsychology at St. Joseph's College (Philadelphia), has been made possible by a grant from the Parapsychology Foundation in New York to Carroll B. Nash, professor of biology at St. Joseph's. The laboratory, which will be headed by Nash, will deal with phenomena of extrasensory perception. The only other such laboratory in this country was opened in the early 1930's at Duke University.

Grants, Fellowships, and Awards

■ The American College Health Association has announced that Continental Casualty Company has established grants in support of promising research in student medicine. The purpose of these grants is to encourage investigation that will promote the physical and mental health of college students and benefit student medical practices.

Two grants of \$500 will be made annually; one grant will be awarded to

support research in a college of less than 2000 enrollment, and one grant will be awarded to a college of more than 2000 enrollment. An award can be used for either clinical or experimental research. The funds can be used as the sole source of support for an exploratory or small-scale study, or they can be used in conjunction with college or other funds to support sections of a large-scale research project.

Recipients will be selected annually by the Committee on Research of the American College Health Association. Member colleges are invited to submit research proposals (6 copies) at any time. Proposals should be mailed to John Summerskill, Student Medical Clinic, Cornell University, Ithaca, N.Y.

■ The Commonwealth Fund has announced the allocation of unrestricted grants totaling \$4,850,000 to seven university medical schools. The awards may be used in whatever ways the schools consider most effective to improve their programs of medical education.

These grants bring to a total of \$12,600,000 the amount of such gifts made by the fund since November 1955. This is in addition to the sums expended for specific medical education projects during 1955-56.

The medical schools that received the grants are the Albany Medical College of Union University, \$500,000; the George Washington University School of Medicine, \$500,000; the University of Pennsylvania School of Medicine, \$500,000; the Boston University School of Medicine, \$600,000; the University of Rochester School of Medicine and Dentistry, \$750,000; the Johns Hopkins University School of Medicine, \$1 million; and the Stanford University School of Medicine, \$1 million.

■ The Glycerine Producers' Association has announced that the fifth annual Glycerine Research awards are now open and that nomination blanks are available. The first award is \$1000 and an honor plaque, the second is \$300, and the third is \$200.

These awards are granted for independent research leading to new and improved applications of glycerine or glycerine derivatives to products or processes. Copies of a bulletin that gives details about the awards may be obtained from the Glycerine Producers' Association, 295 Madison Ave., New York 17, N.Y.

■ The Eastman Kodak Company has announced that it will support 34 predoctoral fellowships in 1956-57 for students working toward degrees in physics, chemistry, or chemical engineering. Grants will be made to 34 colleges and universities in the United States and

Canada; the educational institution will select the fellowship recipient. The cost of these fellowships is more than \$100,000. The fellowship program is part of Kodak's over-all aid-to-education plan, which last year amounted to about \$650,000 and benefited more than 100 educational institutions and organizations.

Each fellowship grant provides at least \$1400 for the recipient; for those who are married and have dependent children, the amount is \$2100. In addition, \$1000 is given to help defray the student's research expenses during the fellowship period. The grant also provides tuition and fees, and funds for the student to attend one professional meeting in his field of study.

■ The Ciba Foundation has announced its 1957 awards program for papers on problems of aging. Not less than five awards, of an average value of £300 each, are available.

Entries will be judged by an international panel of scientists that includes: Prof. C. H. Best (Toronto), Dr. E. Braun-Menendez (Buenos Aires), Prof. E. J. Conway (Dublin), Prof. G. W. Corner (New York), Prof. A. Haddow (London), Prof. V. R. Khanolkar (Bombay), Prof. R. Nicolaysen (Oslo), Dr. A. S. Parkes (London), Prof. F. Verzar (Basle), and Prof. F. G. Young (Cambridge). In making the awards preference will be given to younger workers.

The work submitted should not have been published before 31 May 1956, although it may be under consideration for publication at that date. A paper may be in the candidate's own language. It should not be more than 7000 words in length, and a summary in English not exceeding in words 3 percent of the length of the paper must be attached. If there are coauthors, the name of the leading author should be indicated; it is to him that the award will normally be made, and it will be left to his discretion to share this award appropriately with his colleagues.

Copies of the regulations and application forms must be obtained before an entry is submitted. Entries must be received *not later than 31 Jan. 1957* by the director of the foundation, G. E. W. Wolstenholme, Ciba Foundation, 41 Portland Place, London, W.1, England.

■ The Cranbrook Institute of Science has announced that a 1-year fellowship is available to a scholar seeking an opportunity to work in Michigan in one of the geological or biological sciences or in ethnology. Candidates may be postdoctoral students or persons who have recently retired.

The stipend is \$4500, with limited ad-

ditional research funds and residence. An applicant should submit full credentials and an outline of his proposed program *before 1 July* to: Director, Cranbrook Institute of Science, Bloomfield Hills, Mich.

■ The Ethyl Corporation has announced an expanded program of aid to education, including for the first time the award of graduate fellowships to science teachers and scholarships to undergraduate students. The \$50,000 program is effective with the forthcoming academic year. It provides 18 graduate research fellowships in chemistry, chemical engineering, and mechanical engineering; three graduate fellowships for college and high-school science teachers; and five undergraduate scholarships in chemical and mechanical engineering. The awards will be made to 24 institutions.

The graduate research fellowships, which Ethyl has awarded continuously since 1937, provide each recipient with \$1500 for living expenses and an allowance for tuition and fees. The university department concerned receives \$500 for expenses in connection with the fellow's research work.

The undergraduate scholarships, covering tuition and a part of the student's living expenses, are intended to supplement his own resources and income. Up to \$1200 will be provided to recipients at private institutions. The maximum for those attending tax-supported schools is \$800.

One of the three teacher fellows to be supported will be a member of the science department of a teacher's college or school of education. Under the fellowship, he will attend Columbia University for a year. The other two fellows, both high-school science teachers, will attend workshops this summer at Louisiana State University.

Miscellaneous

■ Cornell University has recorded the voices of 40 insects on a disk that is the ninth in a series of wildlife recordings. The insects are all native to the eastern United States.

■ The American Mosquito Control Association has compiled a list of mosquitoes that bite, of which there are at least 138 different species in North America. One species does not bite human beings but only frogs. The list of mosquitoes was compiled by Harry D. Pratt of the Public Health Service's Communicable Disease Center, Atlanta, Ga.

■ The *Proceedings—Second General Assembly* of the Engineers Joint Council is available for \$1 from the council, 29 W.

39 St., New York, N.Y. The 68-page pamphlet includes a discussion of the Reserve Forces Act of 1955 by representatives of the Selective Service Department of the Department of Defense, and of the findings of the Hoover Commission. It contains not only the formal talks at the EJC general assembly, which was held in New York, 26–27 Jan., but also the questions and discussions from the floor.

■ The National Academy of Sciences—National Research Council has announced the release of *Industrial Research Laboratories of the United States (1956)*, the tenth edition of an annotated directory that has been compiled and published by the NAS–NRC since 1920. The new edition includes information on 4834 laboratories of 4060 companies gathered during the first half of 1955.

The entry for each organization reported shows the names and locations of its laboratories, its principal research executives, the number of professional, technical, and the administrative employees in each laboratory and the kinds of research in which they are engaged. In addition, as an aid in finding individual laboratories or subsidiaries of large companies, an effort has been made to report the entire structure of an organization under its parent company's name with extensive cross-references to component units, subsidiaries, and laboratories.

A simple alphabetic code indicates the types of research services performed by each laboratory, showing whether it undertakes research only for its parent company or sponsor or whether it also does fee or contract research for others, whether it offers consultation or advice, and whether it does testing and analysis. The code also indicates the kind of sponsorship under which each laboratory operates; that is, whether it is owned by a commercial organization, by a nonprofit research institute, by a trade association, or is an independent commercial laboratory. Government and university research and development laboratories are not included.

An index of research activities lists well over 1000 major subject headings. A 10-page index of the geographical location of the laboratories is also included. The usefulness of the directory for reference purposes is further increased by the addition of an edge index to the alphabetic listing of the laboratories.

Industrial Research Laboratories may be purchased from the Academy–Research Council through the Publications Office for \$10 per copy. Discounts are given to all educational and other nonprofit organizations, all local and state governments in the United States, and to all units of the Federal Government.

Reports and Letters

Aromatic Excretory Pattern of Schizophrenics

It is now well recognized that certain aromatic derivatives, such as mescaline and lysergic acid diethylamide (LSD-25), can induce in normal persons transient mental disturbances that bear certain resemblances to the symptoms of schizophrenia. It has been suggested that schizophrenia may involve a metabolic error that results in the biosynthesis of a similar hallucinogen. Such a hypothesis is strengthened by the fact that the hallucinogen LSD-25 has an antagonistic action on certain biological effects of the tranquilizing agents reserpine and Frenquel, α -(4-piperidyl)benzhydrol hydrochloride (1).

The known hallucinogens and tranquilizing agents differ greatly one from another in structural complexity, but all possess one common and perhaps significant structural characteristic—an activated aromatic ring. It is tempting to hypothesize, therefore, that, if any natural hallucinogen existed, it would also belong to this broad class of activated aromatic compounds. On the basis of these assumptions, one might expect to find differences between the aromatic excretory patterns of schizophrenics and normal individuals.

Reports of such differences have already been made. Young *et al.* (2) have reported the presence of abnormal diazo-coupling compounds in the urine of schizophrenics. Sano (3) has reported that tests for certain indole derivatives are positive in a higher percentage of the urines of schizophrenics than they are in the urines of normal individuals. As a first step toward establishing whether or not aromatic pathways are altered in the schizophrenic state, we have set out to confirm and extend these results (4).

Descending chromatograms on urine were run using a 4/1/1 butanol-acetic acid-water solvent with diazotized sulfanilic acid as the color developer (2). One group consisted of the morning urines of 104 females from Essondale, the British Columbia Mental Hospital. Of these, 52 were schizophrenics, 36 were patients with other types of mental disorders, and 16 were members of the staff. All 104 persons were receiving the

normal hospital diet, and all the samples were taken on the same day. Each of the chromatograms was assigned a quantitative rating based on the number and intensity of spots. Ratings of the chromatograms, done independently by two observers, agreed exactly in 78 cases and differed by only one point in the other 26 cases; 0.05 ml of urine was used for each chromatogram.

There are two problems that arise in comparing semiquantitatively the chromatograms of different urines. One concerns the relative dilution of the urine, and the other the amount of a given material represented by the developed spot. Customarily, the urine volume spotted on the chromatogram is normalized to a constant creatinine concentration, while the amount of material developed on the paper is estimated by the area of the spot or by its photorefectance. The creatinine excretion by schizophrenics is abnormal and variable (2, 5), and this, coupled with our observation that diluting or concentrating the urine within physiological limits had little effect on either the size or intensity of spots developed, convinced us that spotting a constant volume of overnight urine was a satisfactory technique. We discovered also that assigning a quantitative rating based on the number and intensity of spots was as satisfactory a technique for differentiating chromatograms as the more laborious measure-

ment methods and, in addition, was just as reproducible and much faster. We have therefore reported only these quantitative ratings.

The results, which are summarized in Table 1, indicate clearly that, taken over-all, there are more diazo-coupling compounds in the urine of schizophrenics than there are in the urine of non-schizophrenics. The greatest differences between the chromatograms of schizophrenic and normal urine appeared to be in the R_f regions 0.15 to 0.3, 0.45 to 0.6, and 0.8 to 0.9. A more exact study of the location and color of the "abnormal" spots will be reported later (6). The day-to-day variation in the aromatic excretory patterns of given individuals, whether schizophrenic or nonschizophrenic, makes it hazardous to say that any given chromatographic spot is exclusively schizophrenic. The differences between schizophrenics and nonschizophrenics are quantitative rather than qualitative, and they become apparent when the over-all aromatic excretory pattern is considered.

Based on a scale of 11, the average value for schizophrenics was 6.0 ± 2.5 as compared with 2.8 ± 1.3 for normal individuals. Of the 13 schizophrenics with a chromatographic rating of 3 or less, 10 were responding well to therapy (insulin shock, electroshock, psychiatric treatment); of the 19 schizophrenics with a rating of 8 or more, 18 had shown no response to treatment. Longitudinal studies on selected schizophrenics are now in progress to determine whether the aromatic excretion pattern shifts toward normal in patients who are responding to treatment and whether patients who show a more normal pattern on first admission are more responsive to treatment. Further studies on more than 700 individuals, including many normal persons and about 400 new admissions to the mental hospital, are in excellent agreement with the results detailed here. In

Table 1. Results of chromatograms of urines of normal individuals and schizophrenics. Each chromatogram was rated by assigning one point for each faint spot, two points for each spot of average intensity, and three points for each peculiarly intense spot; the highest rating attained by this method was 11. No prior selection of patients was made. After the chromatographic work had been completed, the diagnoses were obtained from the hospital files. Since some of the patients had been recently admitted, the diagnoses are not necessarily unequivocal.

Subject		No. (and percentage) of subjects with a rating of					Avg. rating deviation	
Type	No.	11-8	7-5	4	3	< 3		
Schizophrenic	52	19 (37%)	10 (19%)	10 (19%)	10 (19%)	3 (6%)	6.0	2.5
Patients with other mental disorders	36	1 (3%)	6 (17%)	3 (9%)	10 (28%)	16 (43%)	2.9	1.4
Normal	16	0 (0%)	1 (6%)	5 (31%)	3 (19%)	7 (44%)	2.8	1.3

more than 80 percent of the new admissions of schizophrenics, the diagnosis was predictable from the chromatographic results.

Sano (3) has reported that the cold Millon's test, the Davis reaction, and the Mitsuba reaction are positive in some 40 to 50 percent of the urines of schizophrenics as opposed to 1 to 5 percent of the urines of normal individuals. Our evidence to date indicates that the results from these tests generally correlate well with the chromatographic ratings, but that the chromatographic ratings give a slightly more sensitive differentiation between schizophrenics and nonschizophrenics.

Reported R_f values for histidine derivatives in the solvent system used suggest that histidine derivatives are not responsible for any of the spots at $R_f > 0.1$. Confirming evidence has been obtained from studies of the changes in excretion pattern of persons on restricted diets (6). Four of the chromogens have been tentatively identified as indican, 3-hydroxyanthranilic acid, dihydroxyphenylalanine, and 5-hydroxyindoleacetic acid. Further studies are in progress.

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20 December 1955

Studies of Chlorotetracycline Biosynthesis and the Preparation of Chlorotetracycline- C^{14}

As part of an investigation of the metabolism of *Streptomyces aureofaciens* Duggar, a number of studies have been made of the sources and intermediate states of the carbons in the chlorotetracycline (CTC) (1) that is accumulated by this organism. The organism studied was a mutant designated as *S. aureofaciens* BC-41, which is a descendant, through a series of mutation treatments, of the original A-377 soil isolate of Duggar.

Table 1. Carbon-14 incorporation into chlorotetracycline.

Labeled substrate	Incorporation (48-hour addition) (%)
Starch- C^{14} , uniformly labeled (8)	17.3
D-Glucose-1- C^{14} (4)	8.6
D-Glucose-2- C^{14} (4)	6.3
D-Glucose-6- C^{14} (4)	14.5
D-Glucose- C^{14} , uniformly labeled	12.2
D-Fructose-1,6- C^{14} (4)	3.4
Glycine-2- C^{14} (8)	52
L-Methionine- CH_3-C^{14}	48
D,L-Serine-3- C^{14}	18
Glycerol-1- C^{14}	6.5
Sodium acetate-1- C^{14}	13
Sodium acetate-2- C^{14}	15
Ethanol-2- C^{14}	7.4
Sodium formate- C^{14}	3.8
Formaldehyde- C^{14}	3.2

Measurements were made of the extent of carbon-14 transfer from a number of C^{14} -labeled metabolites to the carbon skeleton of CTC. For these experiments, the nutrient medium contained, as carbon sources, starch, corn-steep liquor, lard oil, and calcium carbonate (2). The weight ratio of labeled substrate added to CTC that was subsequently formed was less than 0.04. The CTC from each fermentation was isolated chromatographically. The product's radioactive purity was demonstrated by catalytic hydrogenation (3) of the radioactive CTC to a subsequently chromatographically isolated tetracycline (TC) of the same molar radioactivity.

Those metabolites significantly incorporated are presented in Table 1. Metabolites not significantly incorporated (< 3 percent) when added at zero hours were D,L-alanine-2- C^{14} , D,L-histidine-2- C^{14} , D,L-leucine-2- C^{14} , D,L-glutamic acid-2- C^{14} , D,L-methionine-2- C^{14} , adenine-8- C^{14} , guanine-8- C^{14} , urea- C^{14} , glycerol-1- C^{14} , sodium acetate-2- C^{14} , sodium carbonate- C^{14} , and phenol-1- C^{14} . Substrates not significantly incorporated when added at 48 hours, a time of rapid CTC production, were D-glucitol-1- C^{14} (4), L-arabinose-1- C^{14} (4), D-arabinose-1- C^{14} (4), D-arabinose-5- C^{14} (4), D-ribose-1- C^{14} (4), D-xylose-1- C^{14} (4), lactic acid-1- C^{14} , lactic acid-2- C^{14} , succinic acid-2- C^{14} , glycine-1- C^{14} , sodium carbonate- C^{14} , and shikimic acid- C^{14} (5, 6).

The CTC prepared from a fermentation to which starch- C^{14} had been added at the beginning of the fermentation cycle had a specific radioactivity 0.8 to 0.9 that of the starch, indicating that, under these fermentation conditions, 80 to 90 percent of the chlorotetracycline carbon originated from starch. The incorporation data can be considered evidence against a pathway from starch to CTC involving either fructose, pentoses, the Krebs cycle, carbon dioxide fixation, or shikimic acid (6).

The good incorporations observed from a number of metabolites known to be sources of one-carbon groups and the marked differences in extent of incorporation observed between the two differently labeled glycines and the two methionines indicate a role in the biosynthesis for one-carbon groups. The possibility of preferential appearance of carbon-14 from such donors in the 4-dimethylamino group of CTC was tested by degrading CTC, which was prepared from a fermentation containing glycine-2- C^{14} , with alkali (7) and isolating the resulting dimethylamine. Forty percent of the CTC radioactivity was found in the 4-dimethylamino group, which was approximately 4 times that expected from random labeling.

Pure, crystalline chlorotetracycline- C^{14} has been isolated in good yields from fermentations carried out in the presence of starch- C^{14} and in the presence of glycine-2- C^{14} . The specific radioactivity of the CTC that results is limited only by the radioactivity of the starch or glycine available.

The carbon-14 incorporations observed from the afore-mentioned simple substrates suggest that *S. aureofaciens* has the capacity to build the complete CTC molecule from simple materials. Related experiments have shown that *S. aureofaciens* spores can germinate, form mycelium, and biosynthesize CTC in a glycerol-mineral medium containing glycerol as the sole source of carbon and containing ammonium ion as the sole source of nitrogen. The concentrations of CTC accumulated during the glycerol-mineral-supported fermentation cycles were less than those accumulated during the corn-steep-supported cycles, but they show clearly that the organism is able to construct the entire CTC structure from simple beginnings.

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27 December 1955

Shell Mineralogy in Paleozoic Invertebrates

Among the modern invertebrate groups that deposit shells of $CaCO_3$, some employ calcite exclusively, some employ aragonite exclusively, and still others combine discrete layers of each mineral. Several investigators have questioned the evolutionary stability of the mineralogic habit of compact groups, suggesting that there may have been change through time. But it has been possible to answer this question satisfactorily only for the more recent past, the late Mesozoic and Cenozoic. Rocks deposited during this interval have occasionally yielded shells that preserve unaltered their original mineralogy. Moreover, many of the organisms of this interval are so closely related to living forms that little change would be expected. As one attempts to follow groups backward in time, however, unaltered preservation becomes rarer and relationships to living forms more tenuous. Consequently, our answers become more suspect until, finally, among Paleozoic groups, only speculation has been possible.

Bøggild (1) put such speculation on a reasonable basis by assuming that the recrystallization of metastable aragonite to calcite destroyed the shell microarchitecture. With this assumption, he deduced the original mineralogy of the shells of many Paleozoic organisms. Unfortunately, the validity of the assumption could not be tested beyond the Mesozoic, for no Paleozoic fossils had been found that actually preserved the original mineralogy. Recently, however, two collections, one from the Buckhorn asphalt (Middle Pennsylvanian) in Oklahoma and the other from the Kendrick shale (Lower Pennsylvanian) of Kentucky, have yielded large faunas in which the preservation of intricate microarchitectural detail indicates retention of the original mineralogy. These collections appear to be the oldest yet found in

which the mineralogy is unaltered. Some preliminary observations of the mineralogy of several Paleozoic groups are reported here (2). In all cases in which direct comparison was possible, the mineralogy of these shells proved to be the same as that deduced by Bøggild. Therefore, his basic assumption is probably sound and his method applicable to most cases.

The study of the mineralogy of these shells proceeded as follows. In the case of the Kendrick shale material, the discriminations between calcite and aragonite were made with Leitmeier and Feigl's staining solution. The oil-soaked Buckhorn asphalt collections could not be cleaned sufficiently to permit reaction with this solution. Consequently, determinations were made instead by x-ray. Representatives of the following phyla were tested: Brachiopoda, Ectoprocta, Cnidaria, Mollusca, Echinodermata, and Arthropoda.

Brachiopods belonging to six genera were tested and found in each case to be composed exclusively of calcite. This finding supports the conclusion, derived from the calcitic mineralogy of living forms (3) and from the excellent preservation of most brachiopod fossils (1), that the group has always employed calcite. The genera tested, *Derbyia*, "*Chonetes*," *Marginifera*, *Linoproductus*, *Cruithyris*, and *Spirifer*, are distributed in two orders, the Strophomenida, which may have a few living representatives, and the Spiriferida, which has been extinct since the Jurassic.

One tetracoral, *Lophophyllidium profundum*, was discovered in the material and was also found to be composed exclusively of calcite. There has been much speculation about this group, because the living corals, Scleractinia, construct their skeletons of aragonite. The calcitic skeleton of *Lophophyllidium* shows that at least some of the tetracorals were calcitic. The general preservation of the group suggests that most, if not all, genera shared this characteristic.

Fragments of an unidentified Ectoproct bryozoan were recovered and proved to be composed exclusively of calcite, as are most living representatives of the group. The skeletal elements of at least one crinoid, including calyx cups, arm plates, and columnals, have been examined and are entirely calcitic, as are living crinoids and, in fact, all echinoderms. The pygidium of a single trilobite was recovered and, as Bøggild has indicated, was found to be composed entirely of calcite.

The collections contain a large number of gastropods which possess shells that combine discrete layers of calcite and discrete layers of aragonite. *Straparolus* (*Amphiscapha*) *sp.* and an unidentified euomphalacoid have an outer cal-

citic layer and an inner aragonitic one, thus giving some confirmation to Bøggild's conclusion that this mineralogy was characteristic for the group. One specimen of an unidentified bellerophon-tacoid clearly shows a very thin calcitic outer layer and a massive inner aragonitic layer; but, in other individuals of the same species, the outer layer has not been recognized, and any conclusions regarding the mineralogy must be held in abeyance pending further investigation. Bøggild (1) has reported a bellerophon-tacoid from the Ordovician which he considered to have been composed of calcite. It is possible that this group exhibits a temperature response in its mineralogy similar to the responses indicated for some recent mollusks by Lowenstam (3), although there may also have been an evolutionary change in mineralogy.

Among pelecypods, several forms show both calcitic and aragonitic layers. *Chaenocardia ovata* has an extremely thin outer layer of calcite—so thin, in fact, that it has been removed by abrasion over most of the shell—and a much thicker inner layer of aragonite. Other pelecypods that exhibit this characteristic are present but have not yet been placed even in major taxa.

A large number of pelecypods have shells consisting only of aragonite, but of them only *Leda* and *Astartella* have been identified. *Leda* is a nuculacoid, and, since living representatives of this group seem to be wholly aragonitic, it suggests little change in the mineralogy. A majority of the gastropods that were examined consist wholly of aragonite. Genera that have this mineralogy are *Sphaerodoma*, *Shansiella*, *Soloniscus*, and *Trepospira*.

A number of small, probably juvenile, pectenoids were found but could not be identified. Their shells appeared to consist wholly of calcite. In structure, their shells are unlike those of modern pectenoids, which have an aragonitic shell layer between layers of calcite or the structure of *Limipecten morsei* from the Kendrick shale, which Newell (4) believed to have a thin outer ostracum of calcite and a thicker inner ostracum of aragonite. Because of this lack of similarity and because the individuals observed may be juveniles, further investigation of the shell structure of pectenoids is necessary before any conclusions are reached.

A number of nautiloid cephalopods are present in both collections, and several unidentified shell fragments, as well as specimens of *Pseudorthoceras knoxense*, have been tested. The external shell has, in all cases, been found to consist entirely of aragonite, but tests of the cameral deposits of *P. knoxense* have consistently shown the presence of variable amounts of calcite. Thin sections of the cameral deposits show no recrystall-

ization, and it is concluded that the calcite is primary rather than secondary. No evidence was found that supported Bøggild's suggestion of the presence of calcitic layers in the outer shell, but sampling is, of course, quite inadequate to prove or disprove his contention. A goniatite, *Gastrioceras elkhornense*, was also tested and found to be composed of aragonite.

It is hoped that further study of this material will permit determination of the skeletal mineralogy of additional forms and the discovery of the micro-architectural characteristics of many groups. Preliminary tests of oxygen from the carbonate of some of these shells suggest that they will be suitable for O^{18}/O^{16} paleotemperature studies. It may be possible, therefore, to learn much of the temperature requirements and modes of growth of long-extinct forms.

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20 December 1955

Radiation-Induced Fecal Fat Formation in the Rat

Studies on the effect of radiation on fecal fat thus far have not clearly distinguished between the effects of the radiation and the induced anorexia (1). Increases in fecal fat that were noted in human patients by Dodds and Webster (2), following x-ray therapy, were attributed to impaired lipid absorption induced by irradiation. Mead and coworkers (3), maintaining irradiated mice on fat-free diets, showed elevated fecal fats. These authors state that this fecal-fat increase was due to intestinal desquamation resulting from radiation injury. In contrast, Coniglio *et al.* (4), through fat-balance studies, have noted decreased fecal-fat after irradiation but have correlated such changes to the lessening of food intake during this period. To eliminate variation in fat excretion resulting from food intake, the studies reported here have dealt with fasted normal and irradiated rats. Further, since fecal lipid appears to be secreted by the intestinal wall (5), lipogenesis has been studied in

Table 1. Fecal fat in normal and irradiated rats.

No. of animals	No. of determinations	Dose (r)	Fecal fat (mg/g)	Specific activity (count/min mg)*	Total counts (count/min g)
64	31	0	56.4	1.3	75
34	17	1000	60.2		
39	21	1500	82.7	3.5	348

* Acetate- $1-C^{14}$ was administered to 16 normal and seven irradiated animals. Specific activity and total count refer only to these animals.

two groups of animals by intraperitoneal injections of acetate- $1-C^{14}$ (0.1 μ c) prior to the fecal collection period.

Female albino rats weighing 175 ± 15 g were given 1000- or 1500-r doses and fasted 48 hours while they were being kept in metabolic cages. The feces during this period were collected, pooled from two animals, and dried in a vacuum. Aliquots of fecal material were ground, and the total lipid was extracted. This latter process involved two incubations at $40^\circ C$ with an alcohol-ether mixture (3:1) followed by a 12-hour ethyl ether Soxhlet extraction. The isolated lipids containing carbon-14 were analyzed by means of a nuclear-flow counter using a Berkeley scaler.

Fecal-fat excretion, as can be seen in Table 1, shows significant elevation with roentgen dose. Thus the feces from normal animals averaged a fat content of 56.4 mg/g and increased to 82.7 mg/g when a 1500-r dose had been administered. If taken separately, similar comparisons can be made in the groups injected with acetate- C^{14} and the non-injected groups. Here, irradiated animals receiving acetate showed a fecal-fat average of 99.0 mg/g as compared with 58.5 mg in the normals, while those receiving no acetate exhibited 79.2 and 55.2 mg/g under the same respective treatment.

Comparisons of lipogenesis have been made by noting the total counts found in the fecal fat from irradiated and non-irradiated animals. Such comparisons clearly show that the treated rats incorporated into the fecal lipids more than 4 times as much acetate- C^{14} as did the controls. In addition, the increase in specific activity from 1.3 in the controls to 3.5 in the irradiated animals would also be indicative of a stimulation in the fecal-fat synthesis.

Further studies to demonstrate the similarity in composition of the fecal fats from both groups were carried out by fractionating the isolated material into free fatty acids and mono-, di-, and triglycerides. This technique, as outlined by Mattson and Beck (6) showed that the lipid samples contained, on the average, 41 percent free fatty acids, 20 percent monoglycerides, and 39 percent di- and triglycerides from both normal and

x-rayed animals. Since increased lipogenesis has been demonstrated, the possibility seems more likely that this fat originates from intestinal secretion rather than from sloughed-off mucosa as postulated by Mead (3). As further evidence for this view, fecal fat that was fractionated after administration of acetate- C^{14} showed that approximately 50 percent of the total count was in the free fatty acids and monoglycerides, with the remaining 50 percent in the di- and triglycerides in both irradiated and control animals.

Thus, the indications are that lipid of similar composition is being formed by both types of rats varying only in the rate of formation. An attempt to gain further evidence to support this concept by the administration of acetate- $1-C^{14}$ and the analyses of the material isolated from the lumen of the small intestine in normal and irradiated rats is being contemplated.

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14 December 1955

Precipitation of Enzymes during Isolation of Chloroplasts in Carbowax

Two major difficulties in the determination of the intracellular distribution of enzymes are (i) the adsorption of soluble enzymes on particulate matter and (ii) the leaching of enzymes from the particles during the isolation procedures. It has been suggested that leach-

ing of soluble materials from chloroplasts may be reduced by the presence in the isolating medium of high-molecular-weight substances such as polyethylene glycol (Carbowax 4000, molecular weight 2500) (1, 2). McClendon (2) has shown that a buffered solution of Carbowax (40 g/100 ml) is beneficial in maintaining the morphologic integrity of chloroplasts during isolation. In addition, Carbowax tends to prolong the time that such isolated chloroplasts are active in the Hill reaction.

In the hope that Carbowax might prove useful in a study of the intracellular location of enzymes in leaves, its effect on the apparent distribution of amylophosphorylase was investigated (3). Although Carbowax proved unsuitable for this purpose, the results obtained are of interest in view of the use of Carbowax in the isolation of chloroplasts and mitochondria (2, 4). Phosphorylase was chosen as a test enzyme because it is highly soluble and almost always found in the supernatant liquid derived from the centrifugation of sucrose homogenates of starch-free leaves (5). Logically, its presence would be expected within the chloroplasts where starch is usually formed.

One explanation offered for the distribution observed in sucrose homogenates is that phosphorylase diffuses from the chloroplasts during the isolation procedure (6). If this explanation is correct, then a study of the distribution of phosphorylase should be a good index of the effectiveness of any particular isolation

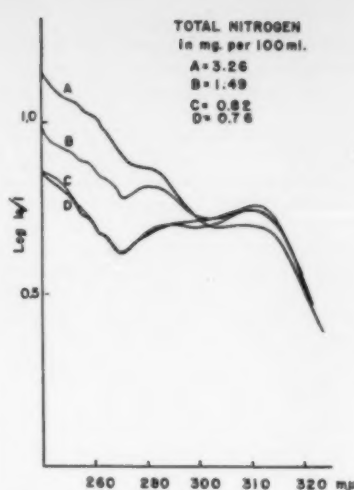


Fig. 2. Ultraviolet-absorption spectra of the supernatant obtained from leaves homogenized in sucrose (0.4M sucrose, 0.1M citrate, pH 6). (A) Supernatant after 20,000 g centrifugation for 10 minutes; (B) the same, to which 2 g of Carbowax per 20 ml had been added before centrifugation; (C) 4 g of Carbowax added per 20 ml; (D) 8 g of Carbowax added per 20 ml.

method in preventing the loss of highly soluble enzymes from the chloroplasts during their isolation.

When starch-free leaves of young tobacco plants were ground in iced Carbowax (Carbowax 4000, 40 g/100 ml of 0.1M citrate, pH 6), more than 80 percent of the phosphorylase was found in the particulate fraction obtained after centrifuging at 1000 g for 10 minutes (Fig. 1). In contrast, when a parallel experiment was run with a sucrose medium (0.4M sucrose, in 0.1M citrate pH 6), more than 90 percent of the enzymatic activity appeared in the supernatant fluid after centrifugation at 1000 g. However, when a solution of Carbowax was added to this supernatant, phosphorylase was precipitated. When the final Carbowax concentration was 20 g/100 ml, approximately 17 percent of the phosphorylase was precipitated. A final concentration of Carbowax (40 g/100 ml) precipitated 90 percent of the phosphorylase (Fig. 1). Qualitative tests indicated a similar precipitation of catalase.

The precipitation of soluble enzymes by Carbowax renders this material of doubtful value in studies of the intracellular distribution of enzymes. Certainly the occurrence of phosphorylase in the chloroplast fraction isolated in Carbowax solution is not evidence of the natural distribution of this enzyme.

McClendon (2) observed, during plas-

tid isolation, that Carbowax precipitated ultraviolet-absorbing material, which he presumed to be nucleoprotein. Figure 2 shows the effect of adding Carbowax in solution to the supernatant obtained from leaves that were homogenized in sucrose solution and centrifuged at 1000 g for 10 minutes. After the addition of the Carbowax, the solutions were centrifuged at 20,000 g for 10 minutes, and the ultraviolet-absorption spectra of the resulting supernatant solutions were determined with the Cary recording spectrophotometer. It was evident from the decreased absorption at 280 mμ that Carbowax 4000 in concentrations of 20 and 40 g/100 ml precipitates protein from the leaf homogenate. The decrease in absorption at 260 mμ is in agreement with McClendon's observations.

These results indicate that, although it may be useful in maintaining the apparent morphologic integrity of the chloroplasts and in stabilizing certain of their biochemical reactions, notably the Hill reaction, Carbowax is not suitable for studies of the intracellular distribution of enzymes. Soluble enzymes and other proteins are precipitated by Carbowax and may contaminate the particulate fractions. Unless a method is employed to remove the precipitated material, chloroplasts isolated in Carbowax will be associated with enzymes not present as normal *in vivo* chloroplast constituents. This effect should be taken into consideration by investigators who use chloroplasts or other cellular bodies isolated in Carbowax solutions.

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29 December 1955

Assessment of Drug Effects on Emotional Behavior

Recent developments in the use of chemiotherapeutic agents for clinical psychopathology have stimulated renewed interest in laboratory-testing methods for assessing behavioral changes associated with such drug administration. Animal-conditioning experiments promise to provide the behavioral control techniques that are basic to such an approach,

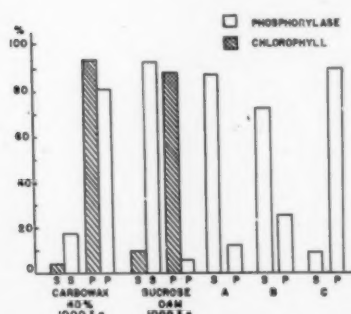


Fig. 1. Effect of Carbowax on the distribution of phosphorylase in leaf homogenates. Phosphorylase and chlorophyll reported as percentage of the total found in the supernatant and the precipitate. (S) Supernatant after centrifugation; (P) precipitate after centrifugation; (A) phosphorylase distribution after the 1000 g sucrose supernatant was centrifuged for 10 minutes at 20,000 g; (B) the same, to which 4 g of Carbowax had been added to 20 ml prior to the final centrifugation; (C) the same, to which 8 g of Carbowax had been added to 20 ml prior to the final centrifugation.

although the selective assessment of specific emotional or affective responses that are of primary interest in this area has continued to present both methodological and theoretical problems. The purpose of the present report is to describe a method, based on earlier animal experimental work (1), for producing and selectively measuring emotional behavior in experimental animals and to present some data that illustrate the use of this method for investigating the behavioral effects of amphetamine and reserpine (2).

Rats and monkeys that had been deprived of solid food and liquids for 24 hours or more were trained to press a bar for a reward of water (rats) or sugared orange juice (monkeys). Initially, the animals received a drop of the liquid reward every time they pressed the lever (continuous reinforcement), although they were rapidly shifted to a schedule on which the bar-press produced the reward only occasionally (average, once in 60 seconds). When the response rates had

stabilized on this variable-interval reinforcement schedule during experimental sessions that lasted several hours or more, a conditioned emotional response of the "fear" or "anxiety" type was superimposed upon the lever-pressing behavior (3). Briefly, this conditioned "anxiety" response consisted of suppression of lever pressing, crouching, defecation, and immobility upon presentation of a clicking noise that had previously been paired with a painful electric shock to the feet. In the present study, the clicking noise was presented at 7-minute intervals during the experimental session and continued for 3 minutes before termination with the grid shock (approximately 1.5 ma) to the feet. Programming of the experimental procedure and recording of the animals' behavior were accomplished automatically by timers, magnetic counters, cumulative-work recorders, and associated relay circuits.

The behavior pattern that develops as a consequence of this procedure is illustrated for one of the rats by the cumulative-response record in the top ("saline"-control) section of Fig. 1. A marked depression in lever-pressing rate is apparent during the 3-minute clicker periods, which are indicated by the short offset sections of the cumulative curve between the straight ("clicker") and broken ("shock") arrows, although the stable lever-pressing rate is maintained throughout the 7-minute intervals between emotional-conditioning trials. After establishment of this pattern, the ratio of the number of lever responses during the clicker periods to the number of lever responses during the nonclicker periods has been found to remain stable (showing no consistent trend) during more than 80 to 100 experimental hours.

The center section of Fig. 1 illustrates the effects of a relatively large dose of amphetamine administered intraperitoneally to the same animal 1 hour prior to this behavior sample. The total number of lever responses during this 1-hour period shows more than a 100-percent increase over the saline-control session, although the rate increase is accounted for completely by increased lever pressing in the 7-minute periods between emotional conditioning trials. The number of lever responses during the 3-minute clicker periods is actually seen to decrease under the influence of the drug.

In contrast, daily intraperitoneal injections of 0.2 mg/kg of reserpine were found, after 4 days, to produce a decrease of more than 50 percent in the total number of lever responses during the 1-hour session for this same animal, although the conditioned suppression of responding during the 3-minute clicker periods was virtually eliminated. The lower section of Fig. 1 shows that, despite the over-all depression in lever pressing, the animal,

under the influence of this drug, continued to respond throughout the 3-minute clicker presentations at the same rate as during the 7-minute intervals between conditioning trials, even though the pain shock continued to be paired with termination of the clicker.

The results obtained with this technique have been replicated with several animals (rats and monkeys) (4). It is clear, however, that the method described does provide an approach to the selective assessment of specific drug-behavior relationships in the affective sphere while providing a control for the general behavioral and motor disturbances that frequently develop as nonspecific side effects of such drug administration.

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References and Notes

1. W. K. Estes and B. F. Skinner, *J. Exptl. Psychol.* **29**, 390 (1941); J. V. Brady and H. F. Hunt, *J. Psychol.* **40**, 313 (1955).
2. I gratefully acknowledge the technical assistance of Irving Geller and Donald Conrad in the conduct of these experiments.
3. H. F. Hunt and J. V. Brady, *J. Comp. Physiol. Psychol.* **44**, 88 (1951).
4. A discussion of these and other pharmacologic agents is in preparation.

5 January 1956

Cork Virus Leafspots on Triumph Sweetpotato Contain Separated Parenchyma Cells

In the autumn of 1954, leafspotting was observed on specimens of the Porto Rico and Triumph varieties of sweetpotato that were growing beside one another on the same bench in a greenhouse at Beltsville, Md. Close examination of the specimens revealed a distinction between the kinds of spots on the different kinds of specimens.

On the Porto Rico variety there were some leaves with few or many chlorotic spots that were later surrounded for a time by a rather sharp, purple ring. This foliage symptom was transmitted within a month by approach and cleft grafting and is now known to be typical of internal cork virosis on this pigmented variety.

On the Triumph variety, a starchy, nonpigmented type, the spots were chlorotic at first, tending to enlarge and become translucent, and were followed later by necrosis. Microscopic examination of free-hand sections revealed the striking fact that the parenchyma cells were uncemented or free and easily separated from one another (Fig. 1). Pressure on the coverslip made the free cells, with their complement of chloroplasts, move apart and separate. Obviously the something or entity causing the spots

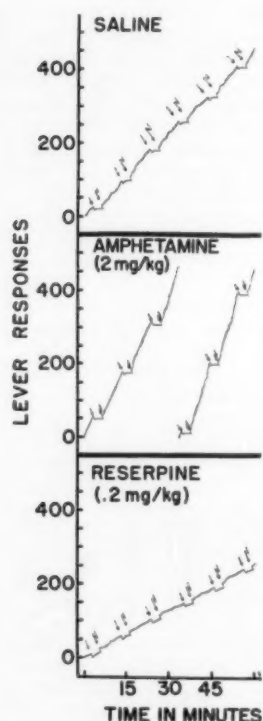


Fig. 1. Sample cumulative-response curves for rat AA-26 showing the effect of amphetamine and reserpine on lever pressing and on the conditioned emotional response. The oblique solid arrows indicate the onset of the conditioned auditory stimulus, and the oblique broken arrows indicate the termination of the conditioned stimulus contiguously with the brief, unconditioned grid-shock stimulus to the feet.

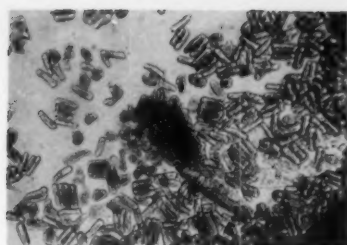


Fig. 1. Parenchyma cells in chlorotic translucent leaf spots on Triumph sweetpotato separated by virus action.

had an enzyme function, and its true nature was proved by the approach-grafting transmission technique to be a virus.

In the autumn of 1955, exactly 1 year later, under similar growing conditions in the same greenhouse, the translucent spots were again prevalent on Triumph leaves. It was then possible, by virtue of the rapid indexing-transmission technique [E. M. Hildebrand, *Science* 123, 506 (1956)] to index this material on potential indicator plants, and on Scarlett O'Hara morning glory it induced typical symptoms of internal cork virosis within 8 days. Repeated in quadruplicate, this experiment gave identical results each time it was performed—that is, Scarlett O'Hara morning glory showed typical virus-induced symptoms within 8 days. Thus, the translucent spots on the Triumph variety were shown to be symptoms of internal cork disease.

Recent microscopic examination of the translucent leafspots again revealed cell separation that resulted from dissolution of the calcium pectate intercellular substance, presumably by enzyme action. The palisade and spongy parenchyma cells from young spots, when separated from each other, open to view their contents, in which chloroplasts are in great abundance and apparently unaffected. This study makes possible micrurgical studies on the physiology and pathology of these living cells of Triumph sweetpotato leaves.

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9 December 1955

Marine Fishes in Fresh Water

At the risk of pursuing a subject too far, I again wish to correct some errors on the subject of marine fishes in fresh water. I have just read the interesting letter from M. Boeseman, of the Leiden Natural History Museum, on "Fresh-water

Sawfishes and sharks in Netherlands New Guinea" [*Science* 123, 222 (10 Feb. 1956)].

After speaking of *Pristis microdon* and its occurrence in both fresh and salt water, he goes on to say "For some species, there are strong indications of breeding in fresh water, a well-known habit of the specimens in Lake Nicaragua." What does he mean by "specimens," sawfish or sharks? The reference is probably to sharks. But no one has ever presented any proof that sharks breed in Lake Nicaragua. Contrary to the oft-published statement, Lake Nicaragua is not landlocked, since it is connected with the sea by its outlet, the San Juan river.

Bigelow and Schroeder, in their monumental work on the sharks of the western Atlantic, mention rapids in the upper San Juan and seem to believe that these prevent sharks from passing up or down the river. From extended observation of fish migrations in tropical rivers with rapids, I have no doubt that in the rainy season sharks are able to make the trip in either direction. Bigelow and Schroeder merely infer that the Lake Nicaragua shark is landlocked and breeds in the lake, but they do not present any proof and do not directly claim that such is the case.

Further on Boeseman is inclined to adopt the theory of gradual upheaval and gradual replacement of salt water by fresh water to explain the presence of essentially marine fishes in rivers and lakes. As an example he cites "jacks (Carangidae)—which do not usually invade fresh water by free will."

This was an unfortunate selection, for certain species of jacks freely enter fresh-water rivers and lakes when they are available. *Caranx sexfasciatus*, which occurs from China and Japan to Australia, and from South Africa to the Hawaiian and Society Islands, enters fresh water in large numbers, usually remaining until they are a year or year and a half old. *Caranx ignobilis*, another jack of equally wide range, also enters fresh water but stays until it is between 2 and 3 years old. These two species are in such abundance in certain lakes that important fisheries at the outlets depend largely on them.

I have records of six species of jacks being taken in Philippine lakes and rivers. In some of these lakes a snapper (*Lutjanus argentimaculatus*) is common and is the basis of an important local fishery. In Tahiti and in Luzon I have taken snake eels in mountain streams. When these species and such coral-reef dwellers as species of parrot-fish (Scaridae) are taken in rivers, and stinging scorpion fish (Scorpaenidae) are taken in hill stream rapids 40 km from the sea, one may well revise his ideas about the adaptability of marine fish to life in fresh

water. One is hardly safe in excluding any group of littoral fishes. In the Solomon Islands schools of *Abudefduf metallicus*, family Pomacentridae, typical of coral reefs, lived in a deep pool between rapids in a river on Malaita Island.

In the Indo-Pacific tropics at least, a great variety of marine littoral fishes may occur in fresh water. Deep-sea fishes, as well as those of the open sea, may safely be excluded from life in fresh water, but one cannot say offhand that any shore fish is incapable of voluntarily entering and living in fresh water.

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21 February 1956

I gratefully accept the opportunity to reply to a few criticisms that occur in A. W. C. T. Herre's discussion of my previous article on "Fresh-water sawfishes and sharks in Netherlands New Guinea" [*Science* 123, 222 (10 Feb. 1956)]. In general, I want to state that the indicated errors are mere misinterpretations.

Referring to my paragraph on *Pristis microdon* and the Lake Nicaragua species, Herre assumes that the word *specimens* refers to sharks. Since the whole first part of this paragraph deals with sawfishes, sharks not even having been mentioned in this or the previous two paragraphs, the word *specimens* evidently concerns sawfishes only. Accordingly there is no reason to discuss Herre's statements on sharks in Lake Nicaragua.

Concerning the sawfishes in Lake Nicaragua, Bigelow and Schroeder [*Fishes of the Western North Atlantic* 2, 39, 40 (1953)] write as follows: "While it may not be strictly landlocked there, in a topographic sense, any more than it is up the Amazon, the fact that Sawfishes breed in the Lake and are rather sluggish in habit makes it likely that most of the local inhabitants are permanent residents." As evidence they give a footnote: "Females taken there dropped their young at the time of capture (Marden, Nat. Geogr. Mag. 96, 1944: 184)." Although it remains possible that copulation takes place in the sea, the quoted statements seem fairly conclusive.

I completely agree with Herre that sharks are able to pass rapids during the rainy season, but this does not interfere at all with my cautiously formulated statement on the migratory possibilities of sawfishes. Moreover, sawfishes are much more sluggish than sharks and probably experience more difficulties when they try to overcome obstacles.

Herre further infers that I am inclined to adopt the theory of gradual upheaval and gradual replacement of salt water by fresh water to explain the presence of

essentially marine fishes "in rivers and lakes." This is a misunderstanding of the general trend of my statement, which, moreover, concerns Lake Sentani only.

In the paragraph under discussion, I state that there seems to be no reason whatever to use this theory for an explanation of the occurrence of sawfishes in Lake Sentani; neither are the facts of gradual upheaval, sustained by considerable geologic evidence, and the gradual replacement of salt water necessary for an explanation of the occurrence in this lake of other "marine" species, an opinion supported by the existence of such species in areas without previous gradual upheaval [for example, the Upper Digoei River near Tanah Merah, 450 km (not miles as I erroneously stated) from the sea]. On the other hand, this gradual upheaval and replacement of salt water may in some cases have helped marine species to get accustomed to fresh water.

I am well aware of the fact that several species of marine fishes, especially in the young stages, occasionally invade fresh water, probably more often than is generally assumed. This is why I cautiously used the expressions "essentially marine" and "not usually." The list of species showing this habit, as given by Herre, is interesting, but as a criticism it is not to the point.

In the large family of the Carangidae, several species are known to occur in outlets of rivers (brackish water), while some even may venture much farther upstream. However, in the Indo-Australian area the number of species showing this habit seems to be small; of the 58 species enumerated by Weber and De Beaufort from this region [*Indo-Australian Fishes* 6, 192 (1931)] only one species is mentioned as entering rivers and occurring in brackish water, a second as occurring in the mouth of rivers, while the cited authors omitted to mention this habit for *Caranx melampygus* from New Guinea [Weber, *Nova Guinea* 5 (2), 249 (1908)]. Although they are evidently incomplete, these data stress the general tendency for a marine habitat in the group.

In the literature on the fishes of Netherlands New Guinea I did not meet with any data on carangid species invading really fresh water. The only locality where, during our voyage to New Guinea, we found fresh-water carangids was Lake Sentani, incidentally a place where upheaval could have been of some influence. If these fishes freely enter fresh water indeed, I wonder why we did not encounter them elsewhere in New Guinea.

I conclude that there is some reason for the opinion that upheaval and gradual replacement of salt water by fresh water helps to explain the occurrence of carangids in Lake Sentani. I am "more

inclined to adopt this theory" in connection with the occurrence of carangids than in connection with the occurrence of sawfishes in the said lake, although our knowledge on the subject seems not yet sufficient to regard this as a definite explanation.

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26 March 1956

Sequences of Metabolic Events during Growth of Synchronized Bacteria

Achievement of synchronized division in growing cultures of *Escherichia coli* B and *Bacillus megaterium* has presented the possibility of a more precise determination of the sequence of metabolic events during growth and division of cells than has been possible previously. Such studies have been carried out in two different laboratories of the University of Pennsylvania, using methods that were developed or modified to be applicable to the two different organisms (1).

Growth of *B. megaterium* was synchronized by the chilling and warming of cultures that were growing in aerated, salt-glucose liquid medium. Samples were taken at frequent intervals. Determinations were made of (i) total cell substance by standard turbidity measurements; (ii) direct cell count in a Petroff-Hausser bacterial counting chamber; (iii) morphologic events on stained preparations by counting for the percentage of cells in the various mitotic stages; and (iv) synthesis of cell nucleic acid components by chemical analyses and ultraviolet absorption.

Similar studies were undertaken with cultures of *E. coli* B. Synchronized growth was initiated by addition of glucose as the only carbon source to synthetic liquid medium containing resting cells with a low RNA/DNA ratio. Cytologic studies of *E. coli* are omitted here.

The components chosen for analysis were (i) the ribose-containing compounds, which were determined by the Bial reaction; (ii) the deoxyribose compounds, which were determined by a modification of the Dische diphenylamine reaction; and (iii) the nucleic acid bases, purines, and pyrimidines, which were calculated from the absorption at 260 m μ read in the Beckman ultraviolet spectrophotometer. Absorption was measured on whole cells and extracted cells, either suspended in glycerol of the same refractive index as the cells or dissolved in 1N sodium hydroxide. All results are here expressed in

terms of micrograms of nucleic acid per milliliter of culture.

Typical experiments are shown in Figs. 1 and 2. In the study with *E. coli* B (Fig. 1), it was found that, immediately after the addition of glucose, the ribose content increased rapidly. The amount of the deoxyribose component rose about the time that the turbidity began to increase. Also, after the increase in ribose content, there was an increase in the nucleic acid bases, which was often followed by division of the cells. The cycle was then repeated. These events are clearly separate in time.

The nonsimultaneous synthesis of the sugar components and the purines and pyrimidines indicates that these components must be considered individually and that readings on one should not be interpreted as representing the total picture for the particular nucleic acid under analysis at a particular time.

Cytologic studies of *B. megaterium* show that the cells, when they are chilled, come into the prometaphase and metaphase stages and are arrested there. When the cultures are warmed, progression through the mitotic stages is resumed, 50 percent or more of the cells being in the same stage at the same time. There is a sequence of chemical events

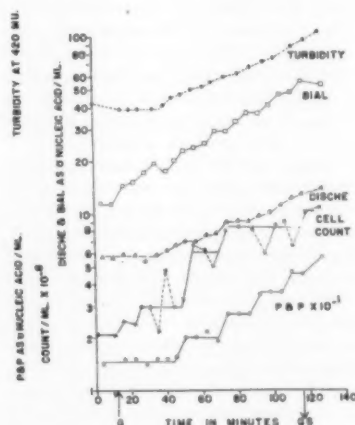


Fig. 1. *Escherichia coli* B. The culture consisted of 180 ml of "52" salt-ammonium sulfate medium at 37°C in a Klett sidearm cylinder, to which was added 28 ml of an overnight-aerated culture that had been chilled for 45 minutes to 5.5°C. The culture was aerated, and at 12 minutes 0.5 ml of 20 percent glucose solution was added (G). The glucose was exhausted from the medium at 110 minutes (GG). Samples were taken for analysis at the times indicated. The cells were counted under the microscope. The purines and pyrimidines (P&P) were determined by absorption at 260 m μ of the whole cells and of the extracts and the extracted cells. The values for the former were averaged with the sum of the latter values.

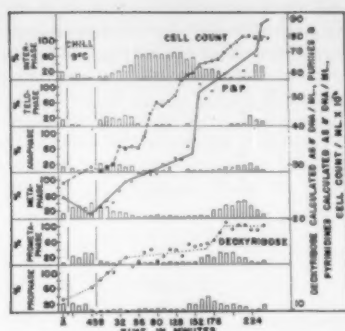


Fig. 2. *Bacillus megaterium* was grown in "M-9" salt-glucose medium at 34° C. The period of chilling was 45 minutes at 9° C. Two hundred nuclei were counted, and the phases were identified for each test interval. Deoxyribose was identified for each test interval with Dische reagent. Purines and pyrimidines (P&P) were determined by absorption at 260 mμ in a Beckman spectrophotometer. Cells were counted in a Petroff-Hausser counting chamber.

that may not be the same for *E. coli*. In both *E. coli* and *B. megaterium*, there is evidence suggesting that there is a fall in the ribose moiety at the same time that there is a rise in the deoxyribose moiety. This in turn suggests that there is a conversion of ribose to deoxyribose in the synthesis of deoxyribose nucleic acid (2).

Details of the methods, results, and possible interpretations of these findings will be presented in other reports (3).

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References and Notes

1. This study was supported in part by grants from the U.S. Atomic Energy Commission, contract #AT(30-1)-1341, and from the National Institutes of Health, U.S. Public Health Service (PHS#C-2189).
2. M. C. Lanning and S. S. Cohen, *J. Biol. Chem.* 216, 413 (1955).
3. E. D. DeLamater, "Bacterial chromosomes and their mechanism of division," in *Bacterial Anatomy* (Cambridge Univ. Press, 1956), pp. 215-260; D. B. McNair Scott and E. C. Chu, in preparation.

5 December 1955

Purification and Crystallization of Coxsackie Virus

Coxsackie A-10 virus (Huebner strain 1816) was grown in suckling mice. Moribund mice were harvested; 1 vol of carcasses was homogenized in 2 vol of 8.6-percent sucrose and cleared (1) of

subcellular particulates. The resulting supernatant, titering 10^6 LD₅₀ per milliliter, was purified as follows.

The fluid was cleared by adjusting to pH 3.0 (normal HCl) and adding 10 g of ammonium sulfate to each 100 ml. After neutralization (with NaOH), virus was concentrated by precipitation through the further addition of 30 g of ammonium sulfate to each 100 ml of suspension. The virus in the precipitate was resuspended by dialysis against 5-percent sodium chloride, cleared, and again cleared at pH 3.0. After neutralization, further clarification was obtained by adding 30 ml of 95-percent ethanol to each 100 ml of suspension. The virus suspension was ultracentrifuged (2) and the virus in the pellet was resuspended in 40-percent ammonium acetate and cleared. The virus suspension was dialyzed against either 5-percent ammonium acetate or 1-percent sodium chloride and ultracentrifuged into a pellet. Finally, the pellet, layered with a small quantity of appropriate salt solution, was stored at about 4°C, as had been done by Schaffer and Schwerdt (3) in crystallizing poliomyelitis virus.

Five lots of from 1 to 1½ lit have been so treated. Three lots were ultracentrifuged and layered with 1-percent sodium chloride, and two with 5-percent ammonium acetate. In the sodium chloride preparations, small dodecahedral crystals with four hexagonal faces were observed in from 1 to 2 weeks of 4°C storage. On resolution, clarification, ultracentrifugation, and 4°C storage, similar dodecahedrons recrystallized, and on continued refrigerator storage, these crystals attained maximum dimensions of about 100 μ (Fig. 1).

Normal suckling mouse homogenate (775 ml) was treated similarly. Ultracentrifugation produced a minute pellet which revealed only a small quantity of amorphous material after prolonged refrigerator storage. Attempts to "recrystallize" resulted in removing almost all of this amorphous material.

The ammonium acetate preparations, on original crystallization, resulted in somewhat ill-defined rectangular and square plates, which on recrystallization appeared clearly as flat, square, or rectangular plates (Fig. 2). Assuming a crystal density of 1, it was estimated volumetrically that more than 1 mg of crystalline material was obtained from each lot.

Both forms of crystal are extremely unstable and have been maintained only in suspension. In this respect, and with respect to shape, they resemble two forms of unstable crystals seen in plants infected with tobacco mosaic virus (4).

The infectivity for suckling mice of the crystalline suspensions has varied

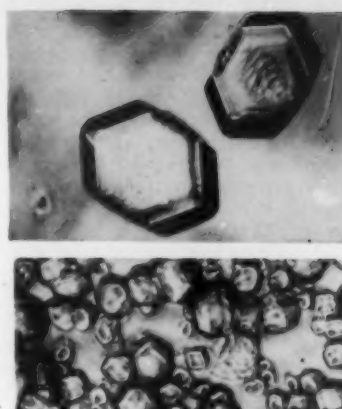


Fig. 1. Second crystallization of dodecahedral crystals in 1-percent sodium chloride. (Top) Late and (bottom) early crystallization seen under phase-contrast illumination.

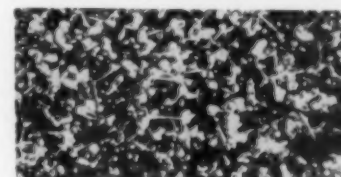


Fig. 2. Platelike crystals seen under dark-field illumination. Second crystallization in the presence of 5-percent ammonium acetate. The small whitish bodies are small plates seen on end and undergoing Brownian movement.

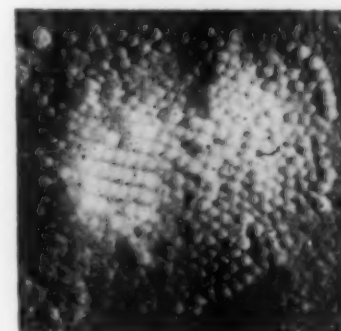


Fig. 3. Electron micrograph of pseudoreplicas of dodecahedron residue dried on agar. Similar pictures have been obtained with the residue of platelike crystals. Several rows demonstrate the potentiality of these particles to form rectangular arrays. [The pseudoreplicas were made and the electron micrographs taken through the courtesy of Bolivar J. Lloyd, Jr., National Cancer Institute, National Institutes of Health]

from 10^{11} to 10^{12} LD₅₀ per milliliter. When the crystals were sedimented by centrifugation at 1000 rev/min for 5 min, the supernatant fluids were found to contain from 0.1 (early in crystallization) to 0.01 (after maximum crystallization) of the infectivity of the supernatant plus the crystals. The crystal pellet accounted for considerably less than 0.1 of the total volume of the suspension. Thus, the calculated titer on a solid milliliter basis approximated 10^{13} .

Since a volume of 1 cm³ can be calculated to contain about 4.6×10^{16} particles of 28-m μ diameter, and since the animal titration showed approximately 10^{13} infectious doses per cubic centimeter, it appeared that the ratio of the total number of particles to the number of infectious particles was apparently greater than 1000 to 1. That a similar discrepancy existed for the starting material is shown by the following.

On the basis of infectivity, the starting material contained 10^{12} particles per liter. Since more than half of the infectivity was lost in purification, at most, 10 μ g of infective particles per liter should have been obtained. However, more than 100 times this quantity of homogeneous particles was crystallized. Apparently, in both the starting and crystalline materials, similar major discrepancies existed between the number of particles and the infectious doses. These discrepancies may be attributed to the inefficiency of the intraperitoneal titration system, the number of particles necessary to establish cellular infection, the degree of aggregation of virus particles, and the ratio of inactive to active virus particles.

When they were dried in air, crystals of either form disintegrated into an amorphous, hygroscopic residue. Therefore, no completely satisfactory electron micrographs showing crystals have been obtained from replicas. Figure 3 shows a pseudoreplica of crystal residue that has been dried on agar. This and other micrographs closely resemble those obtained by Breese and Briefs (5), which probably represented early crystal formation of the same virus. Almost complete aggregation of the virus has been seen throughout these preparations, with orderly alignment of particles 28 m μ in average array diameter. Very little extraneous material has been seen in pseudoreplicas of these recrystallized preparations. The angles formed by hexagonal arrays of particles studied by electron microscopy were found to be the same as those of the hexagonal faces of the dodecahedrons.

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References and Notes

1. Clearing consisted of centrifugation at about 4000 rev/min for 20 to 60 min in an International refrigerated centrifuge (head No. 812).
2. Ultracentrifugation was performed in a Model L Spinco, applying a maximum force of 144,000 g for 60 min. Percentages indicate number of grams in 100 ml of solution. All procedures were carried out at 0° to 4°C. Partially purified preparations were stored at -37°C for varying periods and were usually cleared after they had been thawed.
3. F. L. Schaffer and C. E. Schwerdt, *Proc. Natl. Acad. Sci. U.S.A.* 41, 1020 (1955).
4. F. C. Bawden, *Plant Viruses and Virus Disease* (Chronica Botanica, Leiden, Netherlands, 1939) chapt. 3.
5. S. S. Breese, Jr., and A. Briefs, *Proc. Soc. Exptl. Biol. Med.* 83, 119 (1953).

9 March 1956

New Synthesis of Oxalic Acid

Results indicate that oxalic acid is formed when bicarbonates in aqueous solutions are exposed to beta or gamma radiation. Although the procedure appears less complicated than Wöhler's synthesis of this acid from cyanogen, which was the first "organic" synthesis from "inorganic" materials (1), the mechanism of the reaction is complex, since it involves the presence of water and possibly also oxygen to effect the carbon to carbon bondage of the carbon dioxide moiety.

Solutions of ammonium, calcium, and sodium bicarbonates and sodium and ammonium carbonates were prepared in various concentrations and irradiated in polyethylene bags. In order to allow complete penetration of the ionizing radiation, a large enough bag was used so that the thickness of the filled bag (approximately 250 ml) was nowhere greater than 6 mm. The samples were exposed to beta radiation by means of a 2 Mev van de Graaff electron accelerator. The dose rate was 2.10 Mrep per pass, and the total dosages to which the samples were exposed ranged from 2.10 to 52.5 Mrep.

The chemicals used were of standard analytic grade. Calcium bicarbonate was prepared by passing carbon dioxide through a water suspension of calcium carbonate. The samples, which were irradiated at room temperature, were withdrawn from the polyethylene bags, and the oxalic acid, which was precipitated as calcium oxalate, was regenerated and derivatized. Table 1 gives the characterization of oxalic acid for all series investigated.

These results were repeated when glass vials were used as containers. Owing to the porosity of the polyethylene bags, gas analyses were not attempted.

Oxalic acid was not detected on irradiation of sodium carbonate solutions. Blank tests, carried out with distilled water, were also negative. Formic acid was likewise not observed to form in these reactions. The formation of oxalic

acid from ammonium carbonate is explained by the fact that ammonium carbonate is a mixture of ammonium bicarbonate, ammonium carbamate, and ammonia (2).

Percentage yields of oxalic acid were calculated as 100 times the number of grams of oxalic acid formed per gram of solute. G values (number of molecules

Table 1. Identification of oxalic acid.

Test	Theoretical	Found
Neutralization equivalent		
CHO · 2HO	63	62.5 ± 1.0
Oxalic acid dihydrate, mp °C	100* (1)	100 ± 0.2
Oxalic acid, mp °C	189.5* (3)	190 ± 0.2
Benzylthiuronium oxalate, mp °C	193* (4)	193 ± 0.2
Aniline blue formation (5)	+	+
Infrared spectrum of calcium oxalate†		

* Mixed melting points with authentic materials showed no depression. (All melting points were carried out on Kohler hot stage.)

† Spectrum agreed with standard calcium oxalate curve.

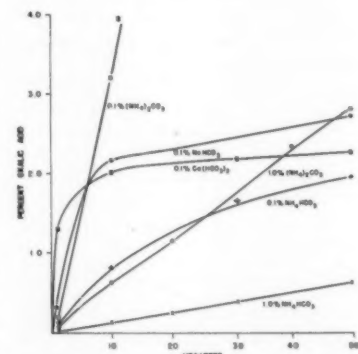


Fig. 1. Oxalic acid yield versus irradiation dose.

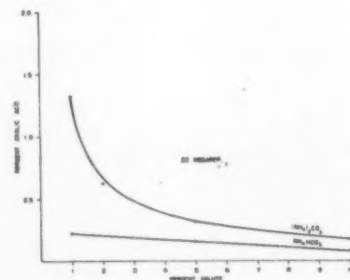


Fig. 2. Oxalic acid yield versus concentration of solution.

formed per 100 ev where 52.4×10^{18} ev is equivalent to 1 Mrep) may be obtained by simple calculations from values in Figs. 1 and 2.

It was qualitatively determined that gamma irradiation at similar dosages also results in the formation of oxalates from the afore-mentioned bicarbonates and ammonium carbonate.

The yields of oxalic acid, obtained by permanganate oxidation, for varying concentration and dosage levels are presented in Figs. 1 and 2, respectively.

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5 December 1955

Paradamite, a New Zinc

Arsenate from Mexico

A suite of minerals from the Ojuela Mine, Mapimi, Durango, Mexico, was received recently for examination. The principal minerals identified were legrandite, $Zn_{14}(OH)(AsO_4)_9 \cdot 12 H_2O$; plattnerite, PbO_2 ; murchisonite, Cu_6PbO_{15} ; and a new species having the composition $Zn_2(AsO_4)(OH)$, which has been named paradamite (1). The material was collected by George Griffith, and submitted for study by George Burnham. The type specimen is in the U.S. National Museum, catalog number 107443.

A chemical analysis of paradamite gave ZnO , 56.22; FeO , 0.45; Fe_2O_3 , 0.12; As_2O_5 , 40.17; H_2O (+), 3.44; H_2O (-), none; sum 100.40 percent (G. Switzer, analyst). The theoretical com-

position of $Zn_2(AsO_4)(OH)$ is ZnO , 56.77; As_2O_5 , 40.09; H_2O , 3.14. Paradamite is triclinic and is a dimorph of adamite, which is orthorhombic. It is also the arsenic analog of tarbuttite, a triclinic form of $Zn_2(PO_4)(OH)$.

Paradamite occurs in sheaflike aggregates of triclinic crystals and in somewhat rounded and striated equant crys-

Table 2. X-ray powder diffraction data for paradamite, tarbuttite, and adamite (copper K α radiation, $\lambda = 1.5418 \text{ \AA}$, camera radius = 114.59 mm).

Paradamite		Tarbuttite		Adamite	
d (Å)	I	d (Å)	I	d (Å)	I
6.33	10	6.19	10	5.99	8
5.44	6	5.44	5	5.47	1
4.77	2	4.60	5	4.96	10
3.99	3	3.88	1	4.29	8
3.71	10	3.71	8	3.79	6
3.34	5	3.28	6	3.31	1
3.16	6	3.09	4	3.06	3
3.08	7	2.99	7	3.00	10
2.99	9	2.88	8	2.71	9
2.84	9	2.78	9	2.64	6
2.76	1			2.59	5
2.73	1	2.71	2		
2.57	6	2.54	5	2.54	5
2.53	1				
2.49	8	2.48	6	2.47	10
2.45	3	2.42	7	2.43	8
2.39	3	2.36	6	2.36	7
2.32	1	2.29	1	2.09	2
2.18	2	2.22	2	2.01	2
2.13	1	2.10	3	1.97	4
2.11	7	2.06	7	1.92	3
2.08	5	2.02	3	1.89	3
1.99	1	1.95	3	1.86	2
1.95	1			1.82	1
1.91	2			1.78	1
1.88	1			1.75	2
1.84	1	1.85	4	1.72	4
1.82	2	1.82	2	1.67	5
1.79	4	1.80	2	1.64	3
1.76	2	1.74	4	1.62	7
1.72	4	1.71	4	1.60	3
1.67	3	1.60	3	1.58	5
1.58	4	1.58	1	1.52	5
1.55	2	1.54	2	1.49	5
1.54	4				
1.51	3				
1.48	4	1.48	1		

tals up to 5 mm in size. It has a perfect {010} cleavage. It is transparent and pale yellow in color, with a white streak. The luster is vitreous and, on the cleavage, pearly. Optically it is biaxial (-) with $2V = 50^\circ$, $\alpha = 1.726$, $\beta = 1.771$, $\gamma = 1.780$ (± 0.002). The specific gravity is 4.55 ± 0.02 . Paradamite was found with mimetite and adamite on a matrix of limonite but not on the same hand specimen as legrandite, plattnerite, or murchisonite.

Properties of paradamite, tarbuttite, and adamite are compared in Tables 1 and 2 (2).

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Notes

1. Publication of this paper was authorized by the secretary of the Smithsonian Institution, Washington, D.C.
2. A detailed crystallographic description of the new mineral is in preparation.

17 November 1955

Loss of Nutrients from Plant Foliage by Leaching as Indicated by Radioisotopes

That nutrients can be absorbed by the foliage of plants from sprays has been adequately demonstrated through the use of radioisotopes (1). The results obtained by many workers (2-6) indicate that nutrients may also be lost from leaves. However, the implication is that these losses in large part occur as the plant approaches maturity. By use of isotopically labeled nutrients, it is now possible to study the magnitude of these losses, the nature of the compounds lost, and the physiological factors that may affect the rate of loss (7).

Young, rapidly growing plants were allowed to absorb phosphate and potassium solutions labeled with P^{32} and K^{42} through the roots, or P^{32} -labeled phosphate through the bases of cut stems. The plant material was then leached under a mist of distilled water for 4 to 48 hours, and the runoff (leachate) was collected. The leachates were then passed through anion or cation exchange resin columns (8), and the collected ions were eluted with 5-percent NaOH or HCl. The eluates were evaporated to dryness, and the radioactivity of aliquots was ascertained. Bean (*Phaseolus vulgaris*), sweetpotato (*Ipomoea batatas*), or poinsettia (*Euphorbia pulcherrima*) plants lost no significant quantities of root-absorbed P^{32} . However, cuttings of bean and rose (*Rosa spp.*) lost 1.5 and 12.8 percent respectively, of the labeled phosphate that had previously been absorbed through the bases of cut stems during a 4-hour period. Ten-day-old bean plants that absorbed

Table 1. Physical properties of paradamite, tarbuttite, and adamite.

Property	Paradamite (Mapimi Mexico)	Tarbuttite (Broken Hill, N. Rhodesia)	Adamite (Mapimi, Mexico)
Crystal system	Triclinic	Triclinic	Orthorhombic
Optical	(-) $2V = 50^\circ$ $\alpha = 1.726$ $\beta = 1.771$ $\gamma = 1.780$	(-) $2V = 50^\circ$ $\alpha = 1.660$ $\beta = 1.705$ $\gamma = 1.713$	(+) $2V = 88^\circ$ $\alpha = 1.722$ $\beta = 1.742$ $\gamma = 1.763$
Cleavage	{010} perfect	{010} perfect	{010} good, {010} poor
Specific gravity	4.55	4.12	4.43
Color	Pale yellow	Colorless to pale yellow	Colorless, pale yellow, light yellowish green, bluish green

Table 1. Losses of Rb⁸⁶ and K⁴² from the foliage of bean plants after 4 hours of leaching under continuous mist.

Experimental conditions	Percentage lost in leachates	
	Rb ⁸⁶	K ⁴²
Dark, high salt	14	71
Dark, low salt	7	42
Light, high salt	5	5
Light, low salt	5	12

K⁴²-labeled potassium for 12 hours from the root medium lost 2.2 percent in the leachates.

In later experiments, K⁴² and Rb⁸⁶ were added to water cultures. Bean plants were permitted to absorb the isotopes through the roots for 48 hours and were then removed for leaching. Two salt levels in the water cultures were established by using Hoagland's nutrient solution (9) and diluting it with nine volumes of distilled water. In addition, during the absorption period, half the plants were kept under normal daylight, and half in the dark (under black cloth). Following root absorption of the isotope, plants were cut above the cotyledonary node, the stems were sealed off with molten paraffin, and the above-ground parts of the plants were leached for 4 hours. Analysis of leachates showed that

plants that had been held in the dark lost 71 and 42 percent of the K⁴², and 14 and 7 percent of the Rb⁸⁶ at the high and low salt levels, respectively. Losses of root-absorbed K⁴² for plants that had been maintained in light were 5 and 12 percent at high and low salt levels, respectively, with 5 percent of the root-absorbed Rb⁸⁶ at both levels (Table 1). Standard chemical analyses of plant tissue (Table 2) were used to supplement the radioactivity assay in the K⁴² experiment (10). Approximately 10-percent reduction in the content of Ca, K, Mg, N, and P was found in the leached plants.

Examination of the leachates by means of chromatographic separations using Phenol and water (80:20) and *n*-butanol, acetic acid, and water (4:1:5) as solvents (11), indicated the presence of a ninhydrin-positive constituent with an *R_f* of 0.49 to 0.52 and 0.10 to 0.12 for the two solvents, respectively. Chromatograms of acid-hydrolyzed leachates showed four or five amino acids, suggesting a polypeptide in the original material. A positive Fehling's test indicated that large quantities of a reducing substance or substances had been leached from the leaves; this agrees with the recent report of Dalbro (6).

These observations and those of previous investigators (2, 3, 5, 6) indicate that nutrients are lost from plant foliage

throughout the growing season, with the quantities increasing greatly just before maturity and death of the foliage (2). Light, nutrient level, and maturation of the foliage, and perhaps other variables influence the rate of loss. Such relationships should be considered in sampling and analyzing plant foliage for determining nutrient status. The implication is that nutrients may be lost from above-ground parts of plants during periods of rainfall, or in mist propagation of cuttings (12). These losses may be of sufficient magnitude to alter markedly the behavior of the plant.

Note added in proof: The reducing material has been identified as a galactan. Similar losses have also been found with Ca⁴⁵.

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31 October 1955

Table 2. Chemical analysis of leached and nonleached bean plants.

Experimental conditions	Mineral content as percentage of dry wt.				
	Ca	K	Mg	N	P
<i>Plants not leached</i>					
Dark, high salt	0.76	1.82	0.46	4.89	0.50
Dark, low salt	0.76	1.88	0.44	4.86	0.51
Light, high salt	0.58	1.53	0.36	3.88	0.36
Light, low salt	0.55	1.66	0.36	3.82	0.32
<i>Plants leached</i>					
Dark, high salt	0.64	1.66	0.37	4.44	0.46
Dark, low salt	0.61	1.51	0.34	4.18	0.43
Light, high salt	0.53	1.28	0.32	3.45	0.35
Light, low salt	0.56	1.35	0.33	3.45	0.36

As young investigators acquiring the principles and attitudes as well as the techniques of research, do they [graduate students] learn the rights of independent thought and action or the ways of suspicion and restraint? When they are introduced to research under conditions of secrecy and quarantine from fellow-students and unauthorized faculty members, what is their initial and perhaps lasting attitude toward freedom of choice and expression? Where is the vaunted freedom of science, heard but not practiced?—N. PAUL HUDSON, *Ohio State University Graduate School Record* (December 1951).

Book Reviews

Blood Group Substances. Their chemistry and immunochemistry. Elvin A. Kabat. Academic Press, New York, 1956. 330 pp. Illus. \$8.

Of the human tissues, the most misunderstood has been blood. The effect of blood loss made it reasonable to primitive man that blood was the particular seat of life. The book of Genesis says so, since God tells Noah after the Flood: "Every moving thing that liveth shall be meat for you; even as the green herb have I given you all things. But flesh with the life thereof, which is the blood thereof, shall ye not eat" (Genesis 9: 3-4).

The Greek gods differed physiologically from man in no qualitative way but this: instead of blood, "ichor" ran through their veins. Magic has always made use of blood in its most effective spells. Pacts with the devil are notoriously signed in blood.

As late as during World War II there were serious attempts to keep Negro and white blood separate in the blood banks, presumably to prevent some kind of pollution.

It is a delight then to report that Kabat's book is a complete and readable attempt to reduce some of the mystery of blood to the prosaic level of the test tube.

The book begins with a concise historical background and a short, but clear, description of the genetic factors involved. Kabat makes use of the Fisher-Race nomenclature for the Rh blood groups but carefully steers clear of controversy.

To me the most interesting and vital portion of the book is reached after the methodical discussions of methods for testing the blood-group antibodies and antigens (Chapter 2 may be viewed as a serological manual incorporated into the book) and procedures for the purification of blood-group substances. The portion referred to is that dealing with the chemical composition of the substances (mainly of the A, B, O series.)

Serology, as long as it deals with undefined compounds that can be referred to only by an arbitrary letter system, will always contain something of the mystical. Nor can any search for a substance capable of serving as an inexpensive, readily prepared, and easily preserved reagent for various blood-group factors be any-

thing but a hit-and-miss affair while the blood group substances themselves remain chemical unknowns.

It is heartening then to see how work in the last decade (a goodly portion of it from the laboratories of the author and his associates) has succeeded in partially elucidating the specificity-determining structures of the blood-group substance molecules. The specificity, it turns out, depends on oligosaccharides of relatively short chain length, a fact that makes the prospect for synthetic reagents somewhat hopeful. The importance of the methylpentose, fucose, in this connection is especially interesting. Fucose does not occur in the animal kingdom except in the blood-group substances, and it seems to me that if it should be found to occur in blood-group substances other than those of the A, B, O series as well, it might be a good idea to coin the term *fucopolysaccharides* to differentiate the blood-group substance mucopolysaccharides from those that occur elsewhere.

It seems quite obvious to me that Kabat's monograph will be indispensable to anyone interested in serology and will continue to be looked upon as a classic in its field.

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Louisiana Birds. George H. Lowery, Jr. Louisiana State Univ. Press, Baton Rouge, 1955. xxix + 556 pp. Illus. + plates. \$5.

It is most fitting that a state which ranks among the top six in the country as a place to see birds and which has contributed so much to American ornithology is the first to have a new kind of state bird book. In *Louisiana Birds*, George Lowery has departed from the plain of traditional state bird books by limiting himself to only one objective—introducing "the people of Louisiana to the absorbing subject of ornithology, mainly through the . . . wealth of bird life which is their heritage." His primary concern, therefore, is with presenting the birds of Louisiana in a way that will stimulate the beginner or interested layman to understand and appreciate birds

and to get more pleasure from the study of birds as a sport, as a hobby, or as a science.

A beginner's interest in birds usually begins with an awareness of the many different kinds of birds and their esthetic appeal. This awareness leads inevitably to the next steps: learning the names of birds, how to identify them in the field, and becoming acquainted with some of their remarkable habits. Lowery is obviously sensitive to the needs of the beginner, and he has met them admirably, as is evidenced by the superb illustrations, the warm personal flavor and informality of his style, and his choice of subject matter.

The formal illustrations comprise 40 colored plates, 69 portrait photographs of birds, 14 photographs of habitats, and 135 text figures. Diagrams or paintings of similar species are grouped together for ready comparison to help the beginner see the distinguishing field marks. In addition to the formal illustrations, there are many decorative and informative line drawings, which depict some characteristic habit or feature of the families and orders of birds. The colored plates and line drawings are the work of Robert E. Tucker; almost all of the photographic portraits were taken by Samuel A. Grimes and Allan D. Cruickshank. No resident of Louisiana could fail to be impressed with the bird life that is his heritage after looking at the colored plates and photographs. They will undoubtedly draw many a layman into the field in search of living birds.

In the accounts of the species, which comprise the bulk of the book, there is no uniform treatment or segregation of subject matter under such stylized headings as status, distribution, or description. Instead, there are informal accounts which emphasize regional status, identification, occurrence in Louisiana, and interesting habits. An outstanding feature of many of these accounts is their readability and personal flavor. A bar graph, at the close of species accounts, summarizes the seasonal occurrence and abundance of each species and shows at a glance which species are present in each month of the year. Another great aid to the beginner is provided in the succinct descriptions of the characteristic features of the orders and families of birds.

Preceding the accounts of the species there are 11 short chapters which deal with specific aspects of ornithology in Louisiana and other general topics of interest to a beginner, such as identification of birds, migration, attracting birds, plumage and molt, and conservation. For the person who wishes to know more about birds and the birds of Louisiana, there is a selected bibliography with comments on each of the publications listed.

Lowery's enthusiasm for bird study and his affection for Louisiana and its bird life is evident throughout the book and should prove to be catching. In addition to its other outstanding features, *Louisiana Birds* is well designed and carefully edited. It is an excellent model for a new type of state bird book.

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Advances in Veterinary Science. vol. II.
C. A. Brandly and E. L. Jungherr.
Academic Press, New York, 1955. 449
pp. \$10.

Volume II of *Advances in Veterinary Science* represents the most recent information by some of the international experts who are listed among the editors, advisory board, and the contributors. The addition of L. B. Bull of Australia to the advisory board is most fortunate.

R. E. Shope applies modern epidemiological reasoning to epizootics and indicates the necessity for research on virus reservoirs. C. W. Emmons reviews the literature on mycotic diseases since 1945. H. Van Roekel presents the latest information on chronic respiratory disease in a valuable summary of recent research. L. C. Ferguson discusses the complicated antigenic structure of cattle blood and briefly discusses blood groups in dogs, swine, and sheep. I. J. Cunningham of New Zealand gives an excellent summation of the knowledge of trace-element deficiencies and helps to further unravel the complicated interaction of copper, molybdenum, and geographic types of fodder; he warns against indiscriminate trace-element dosage.

N. T. Clare defines photosensitization and describes three types. Treatment for the hepatogenous type is complicated by the lack of specific therapy for the liver lesions. The chapter on rumen dysfunction, by A. T. Phillipson, is a comprehensive and clear discussion of rumen physiology and biochemistry, including toxic conditions, and of bloat and nervous control. It will give practitioners a great deal of fundamental information on clinical problems of rumination. J. C. Shaw, in a chapter on incidence, etiology, diagnosis, and therapy of "primary and secondary ketosis," unreservedly recommends the most powerful cortisone compounds that are available for its treatment. There is no discussion of contraindications or deleterious side effects. In a short but interesting chapter, D. A. Haig discusses tick-borne rickettsioses in South Africa. They are heartwater of cattle, sheep, and goats; tick-bite fever of man; and *E. canis* rickettsiosis of the monocytes of the dog. Procedures for

diagnosis and specific treatment are given. The important subject of vibriosis is thoroughly covered by W. N. Plas-ridge, who includes the characteristics and serologic features of *Vibrio fetus* as well as the diagnostic measures, transmission, and control in cattle and sheep. The steady decrease in brucellosis has unmasked the serious economic losses caused by *Vibrio fetus*. The "Effective control of internal parasites" by Donald C. Boughton is a valuable summary of the economic magnitude of the parasitic problem in this country. His recommendations for sanitary and drug control of parasites are easily justified by the great economic gain to the livestock industry that would result.

This volume of 449 pages and 1458 references reflects the trend of the rapidly increasing knowledge in veterinary sciences that is a part of the over-all rapid advances in the medical sciences. It should be considered required reading for research workers and teachers in veterinary medicine and a valuable source of the most recent information, summarized by experts, for the use of students and practitioners.

Since the value of this book is due to the great amount of information and experience possessed by its contributors, a paragraph or two on the education and background of the contributors and a short history of their research institutions should have been included in order to increase the interest and understanding of their viewpoints.

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Comparative Endocrinology of Vertebrates. pt. I, *Comparative Physiology of Reproduction and the Effects of Sex Hormones in Vertebrates*. Memoirs of the Society for Endocrinology No. 4. I. Chester Jones and P. Eckstein, Eds. University Press, Cambridge, 1955 (order from Cambridge Univ. Press, New York). 253 pp. Illus. + plates. \$8.50.

This book presents the first part of the proceedings of a symposium on the comparative endocrinology of vertebrates, which was held in July 1954 at the zoology department of the University of Liverpool. The idea of an international symposium on comparative endocrinology, mainly on classes below mammal's, originated with I. Chester Jones of the University of Liverpool. With the help and encouragement of many other people and the support of the Royal Society, National Science Foundation, and Rockefeller Foundation, he organized a con-

ference of more than usual scope and interest. The list of 58 participants, of whom 23 were delegates from France, Holland, North Africa, Canada, and the United States, includes many of the most distinguished names in zoology and the special field of endocrinology.

The book is subtitled *The Comparative Physiology of Reproduction and the Effects of Sex Hormones in Vertebrates*. Most of the 14 papers fall into one or the other category, but much overlap was inevitable. Sex hormones were interpreted as hormones of sex and reproduction and thus included steroids—androgens, estrogens and progesterone, and nonsteroids—gonadotrophic hormones.

The classes of vertebrates are for the most part discussed in separate chapters, seven on the physiology of reproduction, five on effects of hormones, and two of more general import. Those on reproduction include chapters on fish (W. S. Hoar), amphibians (G. J. van Oordt and P. G. W. J. van Oordt; C. L. Smith), reptiles (R. Kehl and C. Combescot), birds (A. J. Marshall; W. R. Breneman), mammals (S. Zuckerman and P. Eckstein). The effects of hormones are treated in five chapters: fish and lower chordates (J. M. Dodd), amphibians (L. Gallien), birds (R. M. Fraps), mammals (J. H. Leatham and R. C. Wolf), the mammalian fetus (A. Jost). In addition, there is a chapter on vertebrate gonadotrophins (E. Witschi) and one on the evolution of viviparity (L. H. Mathews).

With such a wide range of material and a focus on comparative aspects of the subject, the papers might well have been too superficial or encyclopedic and specialized. These extremes are avoided, and a nice balance is maintained. The chairman, S. Zuckerman, in his opening remarks sets the stage by saying, "I cannot recall any endocrinological symposium of recent years which has attempted to range over so wide a field. We not only have the opportunity of trying to construct an up-to-date picture of the comparative endocrinology of vertebrates but also to put old biological problems into the perspective of modern endocrinological concepts, and, at the same time, to relate newer ideas in endocrinology to the facts of zoology." The papers and discussions in the symposium come so close to a successful realization of these broad aims, that the organizers, the chairman, and the participants are to be congratulated.

The reader finds himself advancing in evolutionary progression all the way from the neural gland and reproduction in the ascidian to implantation of the blastocyst and the menopause in the human being. The interesting story of the evolution of viviparity is traced. Old problems are raised: the relation of the hypophysis to the gonads, environmental factors as

modulators of autonomous rhythms, variations in responsiveness of end organs and differences in the substrate on which the hormones act. New and interesting viewpoints are proposed, and if there is not always agreement there is always interesting and stimulating discussion. At the end, in the chairman's closing remarks, Zuckerman ably and skillfully brings together the scattered facts and theories and adds his penetrating comments on the problems of reproduction and endocrinology.

The book is one of the best to appear in this field for many a day and probably the best recent one on comparative endocrinology.

DOROTHY PRICE

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Guide Pratique de Mycologie Médicale.

A l'usage des médecins, des laboratoires et des botanistes précédé d'un tableau d'orientation diagnostique et thérapeutique. Jean Coudert. Masson, Paris, 1955. 364 pp. + plates. Cloth, F. 6000; paper, F. 5200.

If anyone should question the fundamental biological importance of taxonomy in this day of ATP and DNA, he has only to look to the fungi that are pathogenic to man to see a frightening example of the consequences of confused taxonomy and improper nomenclature. Since most of the human pathogens reproduce only asexually, and since all of them are presumably haploid, it is possible for many morphological mutations to become evident, so that to some workers there are almost as many species as there are isolates. This situation, which is perhaps analogous to that in such taxonomically "difficult" genera as *Rubus* or *Crataegus* in the higher plants, has tempted workers to describe a bewildering number of species. Nomenclatorial confusion has been added to this taxonomic difficulty, so that it requires an intrepid and dedicated individual to attempt to bring some sort of order to this chaos. Yet, to do so is of great practical importance to insure accurate diagnosis and appropriate treatment of fungous diseases.

The *Guide Pratique de Mycologie Médicale* is intended to be a simplified guide to medical mycology for the use of clinicians and biologists. The book is divided into three parts. The first part deals with the techniques of medical mycology—methods of taking samples from lesions, methods for direct microscopic examination, media for the cultivation of pathogenic fungi, directions for the macro- and microscopic observation of cultures, verification of pathogenicity by

animal inoculation, and immunological procedures.

The second part of the book is devoted to dichotomous keys for the identification of fungi that have been reported to be pathogenic. One major key provides for the identification of genera that cause mycoses of the epidermis and its extensions; another is for the separation of genera that cause deep-seated mycoses; and more refined keys lead to the identification of species.

The third section of the book contains descriptions of the genera and species treated. The genera are arranged according to a phylogenetic sequence, and within each genus the species are arranged alphabetically. For each species there is a concise statement of the type of disease(s) caused, method of securing samples, appearance under direct examination, macro- and microscopic appearance of cultures, immunology, epidemiology, and, in some cases, the relationships of the pathogen.

One feature of this book which serves to set it apart from many of the recent works on medical mycology is the organization of the major part in accordance with the phylogeny of the pathogens rather than on a basis of the diseases that they cause. This type of organization has the advantage of indicating the position of a given pathogen in the scheme of living things, but the dermatologist might question whether this arrangement is practical for clinical use, and some mycologists may be dissatisfied with the particular phylogenetic scheme that was followed. Moreover, the assignment of some forms that lack sexual reproduction to natural groups may not meet with universal approval. It is surprising, for example, to find *Coccidioides*, the causal agent of coccidioidomycosis or valley fever, assigned, even tentatively, to the Chytridiales when it possesses almost none of the characteristics of this Phycomycete order.

The provision of dichotomous keys for the identification of pathogenic fungi is another unusual and laudable feature of this book; however, the usefulness of the keys could have been extended greatly by the inclusion of adequate illustrations. To be sure, there are eight plates of sketches of assorted structures, but these cannot substitute for clear illustrations of the diagnostic features of each species. In the dermatophytes, at least, it would be difficult for the clinician to supplement the descriptions by consulting illustrations in the most recent books on medical mycology, because the names employed for the genera and species differ from those recognized by workers in this country.

Although the *Guide Pratique de Mycologie Médicale* is to be praised for its approach to a difficult subject, derma-

tologists may find it to be of limited usefulness, because of its brief consideration of clinical symptoms and treatment. Some mycologists may question the validity of many of the large number of species recognized, and all will regret that, through improper citation of species, the book contributes to the confusion of nomenclature which has done so much to hinder the progress of medical mycology.

ROBERT M. PAGE

Department of Biological Sciences,
Stanford University

Cancer of the Lung. Pathology, diagnosis, and treatment. Milton B. Rosenblatt and James R. Lisa. Oxford Univ. Press, New York, 1956. 330 pp. Illus. \$15.

The different chapters of this book are written by specialists in the fields, and I cannot have the specialists' knowledge in all of them. Since it is the same with the reader, my impressions may still be worth while.

The authors, as is stated in the foreword, expect all practitioners of medicine to profit from the book. This is true for the clinical chapters, but it is doubtful how much a nonspecialist can profit from the detailed descriptions of surgical technique and the accompanying small sketches. Some of the x-ray pictures are difficult to interpret, even for a specialist. The general practitioner will not recognize a "thin-walled cavity" in Fig. 8, page 126, or the pneumothorax on Fig. 6B, page 250, and he may be entirely at a loss how to interpret the rectangular shadow on Fig. 6, page 148.

Pathology does not fare much better. In many of the photomicrographs the details as listed in the legends cannot be studied because magnifications are too low or contrast is lacking. The diagrams in the chapter on surgical pathology are instructive, while those concerning radical Roentgen therapy call for a specialist's eye. The chapter on exfoliative cytology also contains pictures that only the specialist can appreciate, but the text makes profitable reading for every physician.

The term *hilar* is used—on pages 50 and 72, for example—in a wider sense than is customary in anatomy and pathology. The fact is justly stressed that more cures cannot be expected from progress in surgical techniques but only from diagnosis in the preinvasive stage. (I would like to add: and from prevention.) At present, cure or long-time survival can be expected in less than 5 percent of the total cases diagnosed. Routine Roentgen examinations in doctors' offices, clinics, and hospitals are considered to

be more efficient and less expensive than general screening. The number of cases detected in this way is too small to affect the total result. Squamous cell tumors seem to have a better prognosis, but the localization is more important.

The chapter on radiation therapy, palliative and otherwise, is long and detailed, while that on psychotherapy is very short. The chapter on the controversial subjects of statistics, geographic distribution and causative factors makes interesting reading. The book is well arranged and well printed; the subtitles at the top of every page are very helpful. I object to introducing the term *bronchiogenic* instead of *bronchiolar*. *Bronchogenic*, which is widely used instead of *bronchial*, is bad enough.

ALFRED PLAUT
Armed Forces Institute of Pathology.

La Genèse des Sols en tant que Phénomène Géologique. Esquisse d'une théorie géologique et géochimique biostasié et rhexistasié. H. Erhart. Masson, Paris, 1956. 83 pp. F. 560.

The 80 pages of text in this book are divided into five chapters: the first setting up and defining the theory of "biostasié." Here the author proposes the new term *rhexistasié*, which may be defined as a sudden break in the biological balance but not the catastrophic type proposed by Cuvier in the last century. Erhart also uses the term *biostasié* for a continuing biological balance but not quite in the same way as Lyell's rules of uniformity would be applied. His contention is that since the days of Lyell and Cuvier many additional facts of geology and geochemistry have been discovered and that these therefore modify Lyell's conclusions.

In Chapter 2 are considered the genesis of soils and sediments showing the importance of vegetable cover in both cases and the several problems connected with them. The question of chronology and its geologic implications are handled in Chapter 3. *Rhexistasié* is again discussed as due to climate evolution in connection with forest cover. Chapter 4 discusses the relation of continental sediments as the red sandstones, the bauxites, the iron-bearing beds (Laterites), and the clays. The land-derived marine sediments are fitted in here.

The last chapter, 5, is entitled "Evolution of the mineral material and biological transformation." In other words, the development of sediments is interdependent on the evolution of life, especially plants. It is a sort of attempt to cross the ideas of Cuvier and Lamarck. To quote, "Evolution of minerals and biologic evolution are both the result of Time, but an essential difference is char-

acteristic of their metamorphism." New forms and new aptitudes develop.

This is an interesting brochure and should bring comment from many areas of earth science. The importance of soil cover on the development of soils and of sediments derived from such areas deserves more attention than it has had. After all, sediments may be simply transported fossil soils. The author makes a fairly good case for his ideas. It seems to me that more examples and more detailed explanation would make a clearer presentation.

E. WILLARD BERRY
Department of Geology,
Duke University

New Books

Biographical Memoirs. vol. XXIX. National Academy of Sciences of the United States of America. Columbia University Press, New York, 1956. 359 pp. \$4.

Immunity, 203 pp., \$5; **The Nature of Viruses and the Origin of Life,** 454 pp., \$7. Hideo Moriyama. Shonan Hygiene Institute, Kamakura, Japan, 1955 (order from Igaku-Shoin, 20 Hongo-6, Bunkyo-Ku, Tokyo).

La Régulation des processus métaboliques dans l'organisme. Théophile Cahn. Presses Universitaires de France, Paris, 1956. 681 pp.

Machine Design. Joseph Edward Shigley. McGraw-Hill, New York, 1956. 523 pp. \$7.75.

Mental Health and Infant Development. Proceedings of the International Seminar held by the World Federation for Mental Health at Chichester, England. vol. 1, *Papers*, 308 pp.; vol. 2, *Case Histories*, 289 pp. Kenneth Soddy, Ed. Basic Books, New York, 1956. \$4.50 per volume.

Fluid Models in Geophysics. Proceedings of the first symposium on the use of models in geophysical fluid dynamics. Held at John Hopkins University, 1-4 September 1953. Robert R. Long, Ed. Sponsored by Office of Naval Research, Geophysics Research Directorate, and U.S. Weather Bureau. Supt. of Documents, GPO, Washington 25, 1956. 162 pp.

Principles of Human Physiology. Charles Lovatt Evans and H. Hartridge. Lea & Febiger, Philadelphia, ed. 12, 1956. 1233 pp. \$12.50.

The Theory of Games and Linear Programming. S. Vajda. Methuen, London; Wiley, New York, 1956. 106 pp. \$1.75.

Psychical Research. R. C. Johnson. Philosophical Library, New York, 1956. 176 pp. \$2.75.

Chemical Market Research in Practice. Richard E. Chaddock, Ed. Reinhold, New York; Chapman & Hall, London, 1956. 196 pp. \$3.

General Biology. Gordon Alexander. Crowell, New York, 1956. 881 pp. \$6.75.

The Growth and Structure of Motives. Psychological studies in the theory of action. James Olds. Free Press, Glencoe, Ill., 1956. 277 pp. \$5.

The Biology of Senescence. Alex Comfort. Rinehart, New York, 1956. 257 pp. \$4.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

The Cultural Heritage of 20th Century Man. Philomathean Lecture Ser., 1955. Pennsylvania Literary Review and Philomathean Society, Philadelphia, 1956 (order from Pennsylvania Literary Review, 3443 Woodland Ave., Philadelphia). 96 pp. \$0.50.

What Are Business and Industry Looking for in College Graduates? Summary of the report of the Detroit Board of Commerce and Wayne University. Harold A. Basilus, Walter A. Crow, Orville F. Linck. Wayne University, Detroit, Mich., 1956. 15 pp.

Teachers Handbook, a Guide to the Interpretation and Follow-up of Achievement Scores. Louis P. Thorpe, D. Welty Lefever, Robert A. Naslund. 1955. 47 pp. \$0.35. **Guide to Good Leadership.** Kenneth A. Wells. 1956. 48 pp. \$0.50. **Combating the Dropout Problem.** Charles M. Allen. 1956. 46 pp. \$1. **Helping Children Discover Books.** Doris Gates. 1956. 48 pp. \$0.50. **Modern Man.** The story of his past development and future possibilities. Ashley Montagu. 1956. 48 pp. \$0.60. **How to Work with Parents.** Maria Piers. 1955. 42 pp. \$1. **Make Your Study Hours Count.** C. d'A. Gerken and Alice Kemp. 1956. 40 pp. \$0.50. Science Research Associates, Chicago.

Second Annual Computer Applications Symposium, Proceedings. 24-25 October 1955. Armour Research Foundation, Chicago, 1956. 108 pp. \$3.

The Production and Properties of Graphite for Reactors. A paper presented at the United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, 8-20 August 1955. L. M. Curries, V. C. Hamister, H. G. MacPherson. National Carbon Co., New York, 1956. 61 pp. Free.

Catalogue of Southern Double Stars. vol. XI, Publ. of the Observatory of the University of Michigan. Richard A. Rosser. University of Michigan, Ann Arbor, 1955. 283 pp.

What Are the Facts about Mental Illness in the United States? National Mental Health Committee, Washington 5, 1956. 36 pp.

Cancer Cytology and Cytochemistry. Annals, vol. 63, art. 6. Ray W. Miner, Ed. New York Academy of Sciences, New York, 1956. 430 pp. \$4.50.

Fibrocystic Disease of the Pancreas. Report of the Eighteenth Ross Pediatric Research Conference. Ross Laboratories, Columbus 16, Ohio, 1956. 92 pp.

The Flavonoids in Biology and Medicine. A critical review. Maurice E. Shils and Robert S. Goodhart. National Vitamin Foundation, New York 22, 1956. 101 pp. \$2.

Solar Radiation, Absorption Rates and Photochemical Primary Processes in Urban Air. Rept. No. 14. Philip A. Leighton and William A. Perkins. Air Pollution Foundation, Los Angeles 14, 1956. 129 pp. \$5.

Industrial Directory of Washington Metropolitan Area. Economic Development Committee, Washington Board of Trade. Washington Board of Trade, Washington, D.C., ed. 2, 1956. 24 pp.

Scientific Meetings

Physiologists Report Recent Work

The 76th meeting of the American Physiological Society took place in Atlantic City 16-20 Apr., in conjunction with the Federation of the American Societies for Experimental Biology. Nearly 500 papers were presented in 55 sessions. Papers on atherosclerosis, tumors, and blood clotting were presented at inter-society sessions in which other members of the federation participated. Of the many excellent papers presented, a few dealing with topics of special interest have been selected for brief notice.

The physiological role of exercise in heart disease was indicated by R. W. Eckstein (Western Reserve University), who demonstrated that forced exercise in dogs was associated with a substantial increase in the coronary vascular collateral supply, and by H. Y. C. Wong (Howard University) who found reduced atherosclerosis in exercised chicks, even though hypercholesterolemia was unaffected. R. W. Wissler (University of Chicago) overcame the resistance of the rat to coronary atherogenesis by using the combined administration of antikidney serum, desoxycorticosterone and sodium chloride. A. Dury (Dorn Laboratory of Medical Research, Bradford, Pa.) reduced the plasma cholesterol/lipid phosphorus ratio and caused regression of atherosclerosis by administration of cortisone in rabbits. M. Friedman (Harold Brunn Institute, Mount Zion Hospital, San Francisco) showed that bile promotes the intestinal absorption of cholesterol by means other than its esterification.

The long-debated concept of the significance of reflected arterial waves on deformation of the pulse wave was critically challenged by L. H. Peterson (University of Pennsylvania). Mechanical impedance to pulsatile blood flow was determined by J. E. Randall (Ohio State University) to depend on three major components: elasticity and inertia of the vessel wall and flow resistance. A new instrument which may permit determination of pressures at the tip of a cardiac catheter was described by F. W. Noble (National Heart Institute): intensity of sound transmitted through the catheter lumen is attenuated in proportion to oc-

clusion of its path by a membrane on which the pressure acts.

In a paper delivered posthumously for C. R. Houck (University of Tennessee Medical Units), high blood pressure was reported to develop following total nephrectomy in sympathectomized animals, thus differentiating this hypertension from hypertensions mediated by the autonomic nervous system. H. E. Ederstrom (University of North Dakota Medical School) measured the regional blood flow of the foot and showed it to be correlated with the temperature of the part. Attention has been called recently to the fact that the kidney is "functionally" distended by blood and an intrarenal fluid. H. G. Swann (University of Texas Medical School, Galveston) demonstrated this fluid to be lymph.

L. Cander (University of Pennsylvania) used ether and acetone absorption techniques to estimate the pulmonary parenchymal mass and determined the pulmonary capillary blood flow by uptake of the less soluble gases acetylene and nitrous oxide. Photographs of the lung surface provided E. P. Radford, Jr. (E. I. du Pont de Nemours and Company) with data for determination of the number and dimensions of pulmonary surface units; utilizing detergents, he obtained results suggesting that surface tension forces are primary determinants of the structure of the terminal air spaces. Pulmonary airway resistance was shown by J. A. Clements (Army Chemical Center) to depend on distributed decreases in airway caliber rather than on segmental reductions in the amount of ventilated lung. H. L. Davis (Mayo Foundation), examining the mechanisms of lung inflation, demonstrated the presence of regulatory receptors in the peripheral bronchi or bronchioles.

F. Ratliff (Rockefeller Institute for Medical Research) illuminated specific sensory elements in the *Limulus* eye, quantitatively inhibiting the activity of adjacent elements. W. Dement (University of Chicago) showed that bouts of rapid eye movement during sleep were associated with sharp reductions in body motility and with specific types and estimated durations of dreams. Emotional displays in patients characterized as aggressive-hostile-active were reported by

F. Elmadjian (Worcester Foundation and Worcester State Hospital) to be related to norepinephrine excretion, while self-effacing-fearful-passive behavior was related to epinephrine excretion.

The growing appreciation of the key importance of the hypothalamus was signaled by a large variety of interesting papers on the physiology of this visceral regulating complex. F. W. Maire (University of Washington School of Medicine) produced immediate eating or drinking responses by stimulation of the diencephalic mammillary bodies. Polydipsia was produced by B. Andersson (Stockholm) on injection of hypertonic saline into the middle hypothalamus, indicating local osmoreceptor activity. N. P. Clarke (Aero Medical Laboratory, Wright-Patterson AFB) produced anti-diuretic effects by carotid injections of saline, but found that femoral injections produced diureses. In independent studies from Texas, R. Guillemin (Baylor University) isolated from hypothalamus tissue a complex polypeptide that stimulated the *in vitro* release of ACTH, while J. C. Porter (University of Texas Southwestern Medical School) extracted, from the blood draining into the sella turcica immediately following hypophysectomy, a globulin that stimulates the normal hypophysis to release ACTH.

M. E. Dumm (New York University-Bellevue Medical Center) demonstrated defects in the carbohydrate metabolism of leukocytes from diabetic patients. P. P. Foà (Chicago Medical School) stimulated the secretion of pancreatic insulin by administering galactose, a sugar that is structurally similar to glucose. H. Bernstein (University of Chicago) reported that adrenal medullary hormone is necessary for the peripheral response to exogenous thyroxine. J. F. Gennaro, Jr. (State University of New York College of Medicine) found that frog skin, like thyroid, concentrated iodine from the surrounding fluid and that this concentrating capacity was enhanced by thyroid-stimulating hormone.

C. M. Connelly (Rockefeller Institute) showed the positive after-potential in perineurectomized frog nerve to be an electric sign of ion-transport processes restoring the resting K ion balance. Differences between the myosins of striated and smooth muscle were found by D. R. Kominz (National Institute of Arthritis and Metabolic Diseases) to reside in sub-molecular structural differences in the amino acid composition of the tropomyosins. After isometric contraction with ATP, L. Lorand (Northwestern University) showed that glycerinated psoas muscle relaxed on addition of phosphoenolpyruvate. D. Gitlin (Harvard Medical School) demonstrated that the terminal amino acid for human alpha lipoproteins was aspartic acid and that for beta lipoproteins was glutamic acid. Ad-

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Proceedings of the Third Berkeley Symposium on Mathematical Statistics and Probability

University of California Press,
Berkeley and Los Angeles, 1956

Vol. I. *Contributions to the Theory of Statistics*

Contributors: Joseph Berkson; Z. W. Birnbaum; Herman Chernoff and Herman Rubin; Aryeh Dvoretzky; Sylvain Ehrenfeld; G. Elfving; Ulf Grenander and Murray Rosenblatt; J. L. Hodges, Jr., and E. L. Lehmann; Wassily Hoeffding; Samuel Karlin; L. Le Cam; Herbert Robbins; Murray Rosenblatt; Charles Stein; B. L. Van der Waerden.

Cloth. List Price \$6.00
Publication Date: 18 August 1956

Vol. II. *Contributions to Probability Theory*

Contributors: David Blackwell; Salomon Bochner; K. L. Chung; A. H. Copeland, Sr.; J. L. Doob; Robert Fortet; J. M. Hammer-sley; T. E. Harris; Kiyosi Itô; Paul Lévy; Michel Loeve; Eugene Lukacs; Karl Menger; Edith Mourier; R. Salem and A. Zygmund.

Cloth. List Price \$6.50
Publication Date: 10 October 1956

Vol. III. *Contributions to Astronomy and Physics*

Contributors: Olin J. Eggen; Jesse L. Greenstein; Harold L. Johnson; Gerald E. Kron; Bengt Strömberg; G. C. McVittie; Jerzy Neyman; Elizabeth L. Scott and C. D. Shane; F. Zwicky; André Blanc-Lapierre and Albert Tortrat; M. Kac; J. Kampé de Fériet; Elliott Montroll; Norbert Wiener.

Cloth. List Price \$6.25
Publication Date: 1 June 1956

Vol. IV. *Contributions to Biology and Problems of Health*

Contributors: James F. Crow and Motoo Kimura; Everett R. Dempster; Jerzy Neyman; Thomas Park and Elizabeth L. Scott; M. S. Bartlett; A. T. Bharucha-Reid; Chin L. Chiang; J. L. Hodges, Jr., and J. Yerushalmy; Jerome Cornfield; David Kendall; William F. Taylor.

Cloth. List Price \$5.75
Publication Date: 5 June 1956

Vol. V. *Contributions to Econometrics, Industrial Research, and Psychometry*

Contributors: Kenneth J. Arrow and Leonid Hurwicz; Edward W. Barankin; C. West Churchman; Patrick Suppes; Albert H. Bowker; Cuthbert Daniel; Milton Sobel; T. W. Anderson and Herman Rubin; Fred-erick Mosteller; Herbert Solomon.

Cloth. List Price \$5.75
Publication Date: 30 June 1956

By a special arrangement, members of the AAAS may purchase any or all of the five volumes at a 25-percent discount. To obtain this discount, orders must be sent to the Statistical Laboratory, University of California, Berkeley 4, California. They must refer to membership in the AAAS and be accompanied by checks for the correct amount. Checks should be made payable to the University of California Press.

dition of carnitine to liver of choline-deficient rats partially corrected disturbances in fatty acid oxidation, according to I. B. Fritz (Michael Reese Hospital).

At the joint session of the federation, clinical aspects of nutrition and cardiovascular disease were presented by L. N. Katz (Michael Reese Hospital), associated biochemical problems by C. B. Anfinsen, Jr. (National Heart Institute) and dietary findings by F. J. Stare (Harvard School of Public Health). Motion pictures on various physiological topics and scientific and commercial exhibits also were presented to the physiologists in attendance.

SIMON ROBBARD

University of Buffalo School
of Medicine, Buffalo, New York

Meeting Notes

■ Scientists and engineers from all over the world will meet at the University of California, Berkeley, 12-16 June, for a world conference on Earthquake Engineering. The conference is presented by the university's Department of Engineering and University Extension in cooperation with the Earthquake Engineering Research Institute, the American Society of Civil Engineers, and the Structural Engineers Association of California. The conference was scheduled to coincide with the 50th anniversary of the San Francisco earthquake of 1906, which gave great impetus to the study of earthquake engineering.

Conference topics include a history of recorded earthquakes, observations of ground motion and damage; predicted response of structures to earthquake motions; and developments in earthquake resistant design and construction in the various seismic regions of the world.

■ The second Canadian Cancer Research Conference will be held at Honey Harbour, Ont., 17-21 June. Sponsored by the National Cancer Institute of Canada, this conference is primarily designed to encourage a review of present knowledge on various aspects of cancer for the benefit of grantees of the institute. The topics to be discussed include the cell, leukemia and chemotherapy, hormones and cancer, and immunity and basic mechanisms.

Since accommodation is limited, attendance must be by application only. Further information may be obtained from Dr. Robert L. Noble, Collip Medical Research Laboratory, University of Western Ontario, London, Ont., Canada.

■ A conference on the metabolism of mucopolysaccharides, which was organized by the Retina Foundation and sponsored by the National Science Foundation, took place in Boston, 1-2 June. Participants included Norman F. Boas, Nor-

walk Hospital; Harry Bostrom, Karolinska Institute (Sweden); David H. Brown, Washington University; Albert Dorfman, University of Chicago; Laurence L. Layton, U.S. Naval Powder Factory; Fritz Lipmann, Massachusetts General Hospital; Karl Meyer, Columbia University; Saul Roseman, University of Michigan; H. G. B. Slack, University of Manchester (England); Morris Soodak, Massachusetts General Hospital; Jack L. Strominger, Washington University.

■ The Association of Southeastern Biologists held its 17th annual meeting 19-21 Apr. at Duke University. Meeting with the association were the Southeastern Section of the Botanical Society of America, the Southern Appalachian Botanical Club, and the Southeastern Division of the American Society of Ichthyologists and Herpetologists.

The following awards were made: H. L. Blomquist, the meritorious award for outstanding contribution to the biological sciences through teaching, provided by the Will Corporation of Georgia; to E. Ruffin Jones, a research fellowship of \$150 at the Mountain Lake Biological Station, provided by Phipps and Bird of Richmond, Va.; and to A. A. Humphries, Jr., of Emory University, the \$100 award for the best paper, provided by the Carolina Biological Supply Company. Humphries' work was on "A study of meiosis in coelomic and oviductal oocytes of *Triturus viridescens*, with particular emphasis on the origin of spontaneous polyploidy and effects of heat shock on the first meiotic division."

■ A seminar on Ship Behavior at Sea will be held at Stevens Institute of Technology 25-26 June. Arranged by the Stevens Experimental Towing Tank Laboratory, the seminar is planned to acquaint naval architects and research engineers with new developments in studies being made of the intricate forces to which ships are subjected on the open sea. The meeting will be under the sponsorship of the Office of Naval Research and the Bureau of Ships.

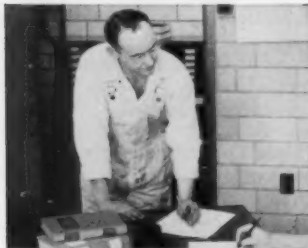
Much of the material to be studied is taken from a Stevens graduate course on the dynamic aspects of naval architecture that was given last winter. The seminar is being held primarily for designers and scientists outside the metropolitan New York area who were unable to attend last winter's classes. Lectures at the seminar will be delivered by four members of the Stevens staff and by three guest lecturers who are specialists in new statistical techniques of analysis.

Those who attend the meeting will be accommodated in student dormitories during the session. A nominal registration fee is being charged for the conference, for which reservations are now being accepted.

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- P5232 p-Chlorophenoxyacetic Acid
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- T5449 2-(2,4-Di-tert.-amylphenoxy)-n-butyric Acid
- 5532 2,4-Dichlorophenoxyacetic Acid
- 6161 p-Ethoxyphenoxyacetic Acid
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- 5238 2-Naphthoxyacetic Acid
- 6568 p-Nitrophenoxyacetic Acid
- 3377 α -Phenoxyacetamide
- 1900 Phenoxyacetic Acid
- 5555 Phenoxyacetyl Chloride
- 1414 γ -Phenoxybutyronitrile
- P5378 α -Phenoxypropionic Acid
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- P5504 (m-Phenylenedioxy)-diacetic Acid
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- P6112 2,4,5-Trichlorophenoxyacetic Acid

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cellulose acetate have also involved them.

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Society Elections

■ Association of Southeastern Biologists: pres.-elect, H. K. Wallace, University of Florida; v. pres., Paul M. Patterson, Hollins College; treas., A. W. Jones, University of Tennessee.

■ American Geophysical Union: pres., Maurice Ewing, Columbia University; v. pres., Lloyd V. Berkner, Associated Universities, Inc.; general sec., A. Nelson Sayre, U.S. Geological Survey, Washington 25, D.C.

■ American Institute of Chemists: pres., John H. Nair, Thomas J. Lipton, Inc., Hoboken, N.J.; pres. elect, Henry B. Hass, Sugar Research Foundation, Inc., New York; sec., Lloyd Van Doren, Watson, Leavenworth, Kelton and Taggart, New York; treas., Frederick A. Hessel, General Aniline and Film Corp., New York.

■ American College of Apothecaries: pres. and representative to the AAAS Council, Leroy Weidle, Jr.; sec., Robert E. Abrams.

■ Gamma Alpha Graduate Scientific Fraternity: pres., Richard A. Popham, Ohio State University; sec., Royse P. Murphy, Cornell University; treas., Robert F. Thorne, State University of Iowa.

■ Ohio Academy of Science: pres., Robert M. Geist, Capital University; sec. and representative to the AAAS Council, Ralph W. Dexter, Kent State University; treas., Elton F. Paddock, Ohio State University.

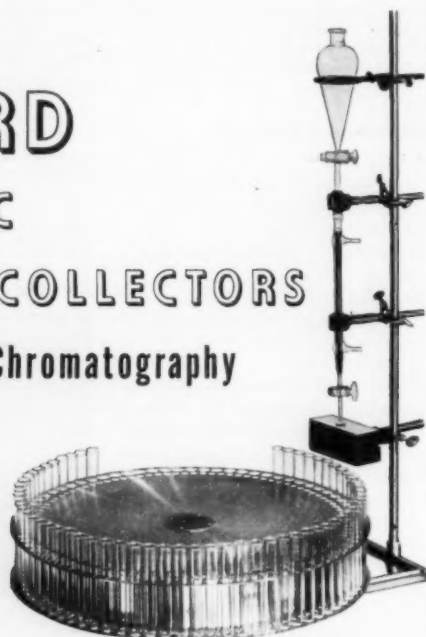
■ Alpha Epsilon Delta: pres., and representative to the AAAS Council, Lloyd R. Gribble, West Virginia University; v. pres., Joseph B. Price, Millsaps College; sec.-historian, and representative to the AAAS Council, Maurice L. Moor, 7 Brookside Circle, Bronxville, N.Y.; treas., Norman F. Witt, University of Colorado.

■ National Association for Research in Science Teaching: pres., Waldo W. E. Blanchet, Fort Valley State College; v. pres., Nathan S. Washton, Queens College; sec.-treas., Clarence M. Pruitt, University of Tampa. Representative to the AAAS Council is George G. Mallinson.

■ Association of American State Geologists: pres., J. T. Singewald, Jr., Maryland; pres.-elect, Olaf P. Jenkins, California; v. pres., John H. Melvin, Ohio; sec.-treas., Eugene Callaghan, New Mexico.

■ American Institute of Electrical Engineers: pres., Mervin S. Coover, Iowa State College; treas., Walter J. Barrett. The vice presidents are Donald E. Garr, Leland F. Stone, J. H. Foote, Norman F. Rode, Mansfield M. Ewell, and Henry H. Kerr.

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Forthcoming Events

July

6-14. International Union of Forestry Research Organizations, 12th cong., Oxford, England. (Secretariat of Union, Viale delle Terme di Caracalla, Rome, Italy.)

9-11. Symposium on Chemical Additives in Foods, 2nd of 5 symposiums, Amsterdam, Netherlands. (H. F. DuPont, International Bureau of Analytical Chemistry, 18 Ave. de Villars, Paris 7.)

11-14. American Malacological Union, annual, San Diego, Calif. (Mrs. M. C. Teskey, P.O. Box 238, Marinette, Wis.)

12-14. International Astrophysical Symposium on Molecules in Cosmic Sources, 7th, Liege, Belgium. (H. C. Urey, Inst. for Nuclear Studies, Univ. of Chicago, Chicago 37, Ill.)

16-17. Symposium on Synthetic Polymer Chemistry, Notre Dame, Ind. (G. F. D'Alelio, Dept. of Chemistry, Univ. of Notre Dame, Notre Dame.)

16-21. French Assoc. for the Advancement of Science, Dijon, France. (Mille-

Henri-Martin, Secretary, 28, rue Serpente, Paris 6^e.)

17-26. International Soc. of Photogrammetry, 8th cong., Stockholm, Sweden. (P. O. Fagerholm, Bragevägen 8, Stockholm.)

18-20. Soc. for the Study of Development and Growth, annual, Providence, R.I. (M. V. Edds, Jr., Brown Univ., Providence 12.)

22-27. International Cong. of Pediatrics, 8th, Copenhagen, Denmark. (Prof. Franconi, Kinderspital, Steinwiesstrasse 75, Zürich 32, Switzerland.)

22-28. International Cong. on Housing and Town Planning, Vienna, Austria. (H. van der Weijde, International Federation for Housing and Town Planning, Paleisstraat 5, The Hague, Netherlands.)

22-28. International Cong. of Radiology, 8th, Mexico, D.F., Mexico. (J. Noriega, Tepic 126, 2^a piso, Mexico, D.F.)

23-26. International Cong. of Developmental Biology, 1st, Providence, R.I. (J. W. Wilson, Dept. of Biology, Brown Univ., Providence.)

25-27. Conf. on Solar-Weather Relationships sponsored by American Meteorological Soc., Boulder, Colo. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

26-28. International Conf. on Biochemical Problems of Lipids, 3rd, Brussels, Belgium. (R. Ruysen, St. Jansvest 12, Univ. of Ghent, Ghent, Belgium.)

27-31. Symposium on Cytodifferentiation (invitation), Providence, R.I. (J. W. Wilson, Dept. of Biology, Brown Univ., Providence.)

27-7. International Limnology Cong., 13th, Helsinki, Finland. (H. Luther, Snellmansgatan 16 C 36, Helsinki.)

30-31. Oak Ridge Regional Symposium, 9th, Blacksburg, Va. (Information Dept., Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.)

30-4. International Physiological Cong., 20th, Brussels, Belgium. (J. J. Reuse, Faculté de Médecine, 115 Boulevard de Waterloo, Brussels.)

August

1-6. International Cong. of Human Genetics, 1st, Copenhagen, Denmark. (Secretariate, 1st ICHG, 14, Tagensvej, Copenhagen, N.)

5-10. International Conf. of Social Work, 8th, Munich, Germany. (J. R. Hoffer, 345 E. 46 St., New York 17.)

6-10. Poultry Science Assoc., annual, Raleigh, N.C. (C. B. Ryan, Dept. of Poultry Husbandry, Texas A & M College, College Station.)

6-1. International Mathematical Symposium on Algebraic Topology and Its Applications, Mexico City, Mexico. (Miss J. Silva, Instituto de Matemáticas, Torre de Ciencias, Ciudad Universitaria, México 20, D.F.)

9-18. International Geographical Cong., 18th, Rio de Janeiro, Brazil. (H. O'R. Sternberg, Centro de Pesquisas de Geografia do Brasil, Faculdade Nacional de Filosofia, Av. Presidente Antonio Carlos 40, Rio de Janeiro.)

10-11. Minnesota Acad. of Science, New London, Minn. (B. O. Krogstad, Univ. of Minnesota, Duluth 5B.)

15-22. Canadian Teachers' Federation, Fredericton, N.B., Canada. (G. G. Cross-

kery, 444 MacLaren St., Ottawa, Ontario, Canada.)

16-21. Symposium on X-Ray Microscopy and Microradiography, Cambridge, England. (W. C. Nixon, Cavendish Lab., Cambridge.)

17-25. International Cong. of Entomology, 10th, Montreal, Canada. (J. A. Downes, Div. of Entomology, Science Service Bldg., Ottawa, Ont., Canada.)

19-23. International Cong. on Diseases of the Chest, 4th, Cologne, Germany. (Executive Offices, American College of Chest Physicians, 112 E. Chestnut St., Chicago 11, Ill.)

19-24. International Symposium on Combustion, 6th, New Haven, Conn. (Combustion Symposium Office, Mason Lab., Yale Univ., New Haven 11.)

20-21. Mathematical Assoc. of America, 37th summer, Seattle, Wash. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

20-21. National Telemetering Conf., Los Angeles, Calif. (R. E. Rawlins, Lockheed Aircraft Corp., Burbank, Calif.)

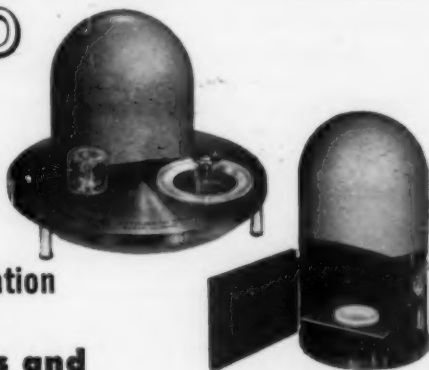
20-24. Conf. on Scientific and Technical Writing, Philadelphia, Pa. (H. F. Arader, Univ. of Pennsylvania, 3400 Walnut St., Philadelphia 4.)

(See issue of 18 May for comprehensive list)

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1 Windowless Flow Counter provides maximum sensitivity for counting solid samples which emit very soft radiations. Common examples are counting alpha particles or low energy betas from isotopes such as carbon-14 and sulphur-35.

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Equipment News

■ **ISOLATING STERILIZER** is arranged for mounting in a wall between sterile and nonsterile rooms. Materials to be sterilized are placed inside the instrument through a door that opens into the nonsterile room. After sterilization, materials are removed through another door that opens into the sterile area. Temperatures up to 260°C may be maintained with adjustable, hydraulic thermostat controls and recorders. (Labline, Inc., Dept. Sci., 3070 W. Grand Ave., Chicago 22, Ill.)

■ **ISOTOPE SCANNER** is used with a scaler and a collimated, directional scintillation detector to scan body areas for concentrations of radioactivity, while simultaneously producing a picture of radioisotope distribution. Commonly used to chart radioactive iodine distribution in the thyroid, the scanner may be used for delineating any other organ in the body in which a radioactive isotope is localized, and it may be set to scan a body area as large as 14 in. by 17 in. (Nuclear Instrument and Chemical Corp., Dept. Sci., 229 W. Erie St., Chicago 10, Ill.)

■ **DISPOSABLE CATH-URINE SET** for female catheterization is sterile and consists of catheter, polyethylene collection bag, and record card. (American Hospital Supply Corp., Dept. Sci., 1210 Leon Place, Evanston, Ill.)

■ **ELECTROLYTIC WATER ANALYZER** for measurement of small quantities of water in gas streams registers water content down to less than 1 ppm, weighs less than 50 lb, and is portable. The instrument operates by passing the wet stream over a hygroscopic substance that is electrically conductive only when it is wet. Quantitative electrolysis takes place, and the water content is determined as a function of the electric current. (Manufacturers Engineering and Equipment Corp., Dept. Sci., Hatboro, Pa.)

■ **CATALOG** of apparatus and accessories for chromatography and electrophoresis has been published by Scientific Glass Apparatus. Such items as chromatocabs, drying ovens, fraction collectors, desalters, and desitometers are described. (Scientific Glass Apparatus Co., Inc., Dept. Sci., 100 Lakewood Terrace, Bloomfield, N.J.)

■ **ANTISMOG TOWER** is claimed to be 100 percent efficient in scrubbing air that is saturated with sulfuric and hydrochloric acids, and 99.0 percent efficient for air that is saturated with nitric acid. Designed for the elimination of acid fumes that are discharged by chemical and industrial plants, the tower is capable of scrubbing 14 to 20 lit of evaporated acid per hour. Gas removal is carried out in three stages—absorption in liquid of the greater part of the gases, elimination of suspended globules of moisture, and neutralization of traces of gas by a chemical reagent that is contained in a tray. (Turner and Brown, Ltd., Bolton, England)

■ **NITROGEN METER** instantaneously indicates percentage of nitrogen in physiologic gas mixtures of nitrogen, oxygen, water vapor, and carbon dioxide. It may be used for lung-function tests, studies of time course of body denitrogenation, and physiologic or clinical measurements of lung volume, respiratory dead space, and abnormalities in distribution of inspired gas. (Custom Engineering Development Co., Dept. Sci., 5103 Eichelberger St., St. Louis, Mo.)

■ **BOOKLET** discusses construction, operation, and applications of instruments recently designed by Polarad Electronics. Included are discussions of a rotating-cylinder viscosimeter, an electron-resonance spectrometer, a recording titrator, and a Stark modulator. (Polarad Electronics Corp., Dept. Sci., Long Island City, N.Y.)

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HEAVY ALUMINUM CONSTRUCTION of outer shell takes pressure up to 100 lbs. Unit can remain connected directly to water source even when outlet valve is turned off, without danger of ruptured cartridge or leakage. **READY FOR INSTANT USE** because the connection to the water source remains unbroken. A reserve of deminealized water is retained at all times. **SIMPLE OPERATION—ION-EXCHANGE Principle:** Replaceable cartridge filled with special resins prevents minerals normally found in tap water from reaching water outlet.

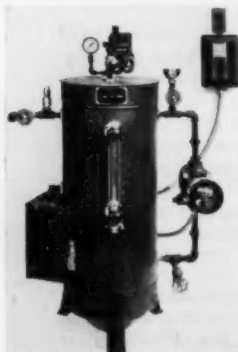
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AQUA-LAB unit, complete with mineral detector, reducing valve, gauge, hose, faucet coupling, metal stand (for permanent installation or portable use) and Ion Exchange Cartridge . . . each \$72.50

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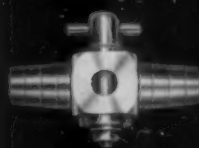
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This flexible corrugated tube is for connecting mask or mouthpiece with Douglas Bag. Length 1 meter, 25 mm. I.D.

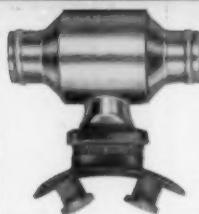
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This Stopcock Valve is aluminum, three-way, with two spigots and normal bore of 1" I.D.

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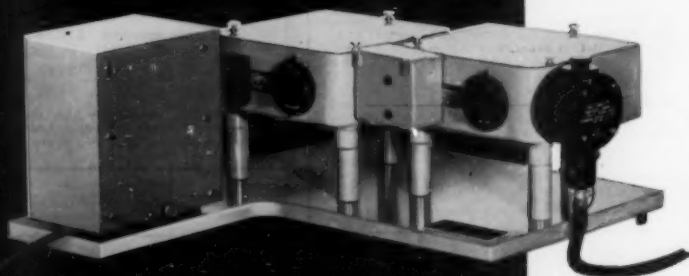
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*Spectrophotofluorometric Assay in the visible and ultraviolet—R. L. Bowman, P. A. Caulfield, S. Udenfriend, Science, Vol. 122, No. 3157, July 1955.

Bulletin No. 820 upon request.

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Physiologist, Ph.D. Research in cellular metabolism, radiation, cardiac neurophysiology, endocrinology, stress and growth studies. Assistant professor—physiology, microbiology, pathology and anatomy. Desires position as head of department or professorship with opportunity to teach and conduct or direct research. M.S. in cytology. Box 143, SCIENCE. X

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COMPANY**
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Microbiologist-Immunochemist, Ph.D. in microbiology for development of biologicals. Qualified in techniques of bacteriology and virology with background in chemical and biophysical procedures related to immunity. Box 140, SCIENCE. X

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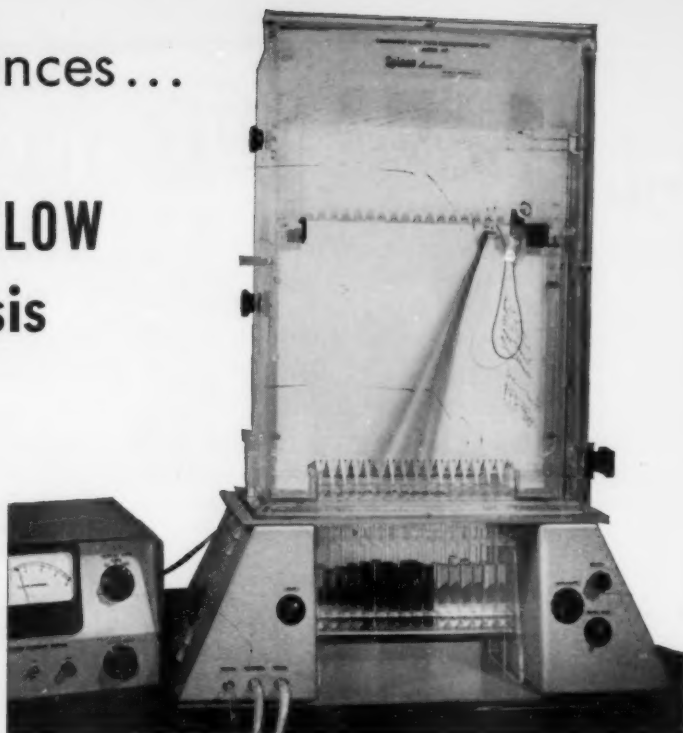
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